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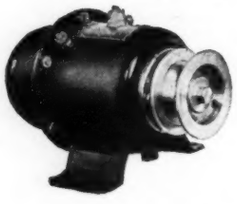

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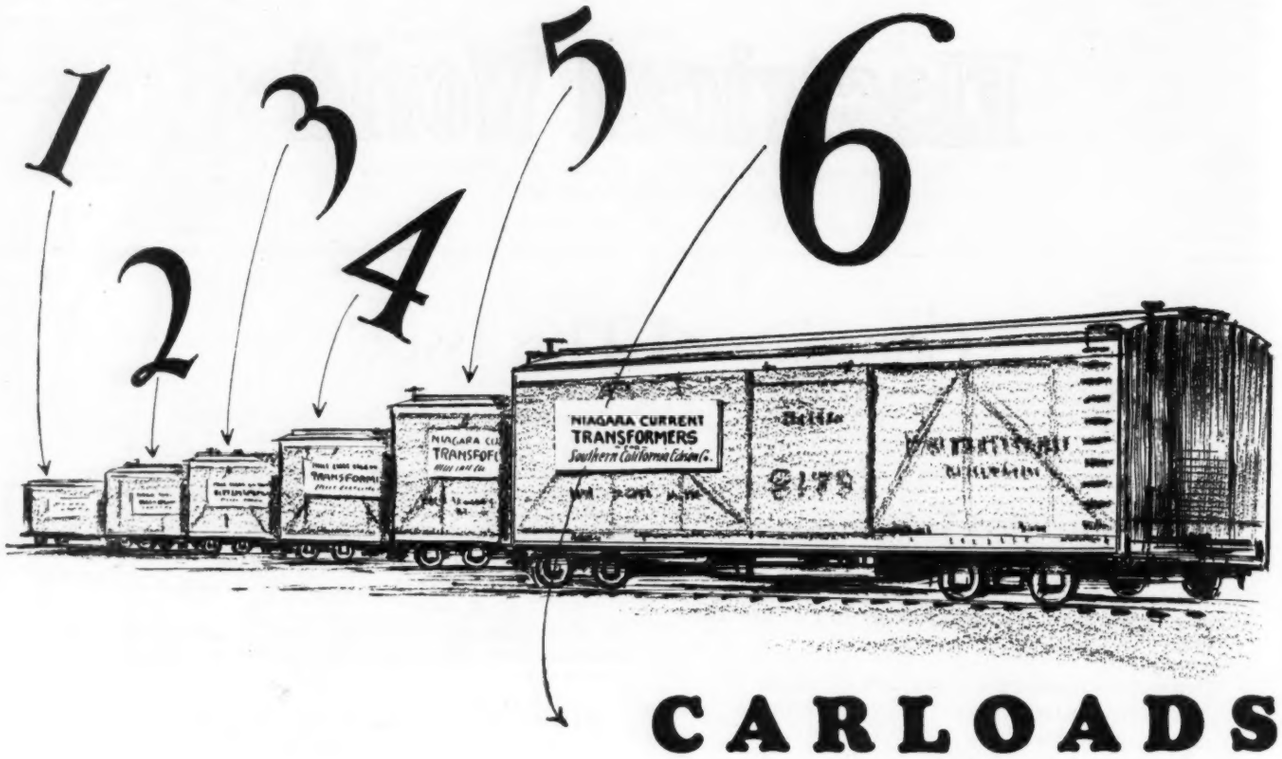

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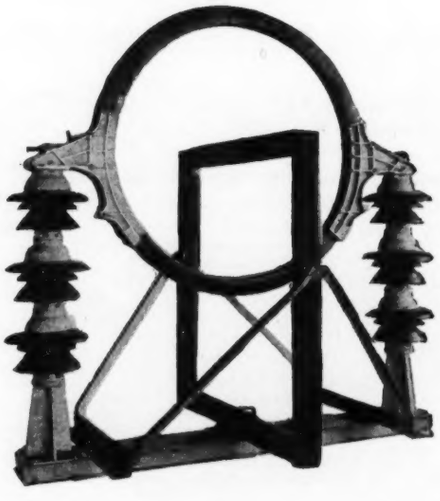

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Electrical World

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W. H. ONKEN, JR.
Editor

VOLUME 90 — *New York, Saturday, September 24, 1927* — NUMBER 13

Is Maine Asleep with an Ace in Her Hand?

BY SLOW degrees Maine is becoming aroused as to the importance of permitting the exportation of her surplus water power. The history of last winter's efforts by far-sighted leaders in business and legislative circles to enact a regulative export law in place of the antiquated Fernald statute confining even surplus hydro power to intrastate use is well known to our readers. Last week's meeting of the New England Council at Poland Spring evidenced the consideration of the interstate compact idea by representatives of the power industry working with the council in its power committee. In a somewhat cryptic statement Governor Brewster intimated his support of this principle.

At the November meeting of the New England Conference in Springfield, Mass., it is probable that the advantages of the compact plan will be favorably discussed. The stage is being set for action at a prospective special session of the Maine Legislature next winter. If politics does not interfere, the outlook will be good for a new deal in the Pine Tree State, assuming the cooperation of Massachusetts and New Hampshire. Meanwhile the art of power production by fuel combus tion progresses apace, putting an increasingly high premium upon imported water power. The odds are certainly not gaining in favor of water powers distan from large markets, and if progressive public opinion in Maine desires to trump any tricks in the interconnection hand before the table is upset by changing economic conditions, early action will be necessary.

* * * *

What Are Public Relations?

PROPER development of public relations does not end with the appointment of a vice-president to have charge of them, nor does it terminate satisfactorily with the formation of a customers' service bureau and a well-schooled commercial department. All know that publicity by press and radio, labor-saving hints for the household, tactful sales persons, courteous cashiers and patient complaint clerks are proved agents for increasing good will, but operating departments have a major and almost unessayed lesson to learn.

The meter reader who hurls a gruff reply over a rapidly departing shoulder in response to a customer's inquiry, the lineman who treads happily on prize flowers, the company truck driver who owns the road, and the engineer who is "not connected with that part of the work" when asked about a perplexing trifle, are all undoing with considerable dispatch the work of many fellow workers.

Public relations are company relations; they are not alone objects of interest to one or another class of employees, but to each and every one, whether it be lineman or president, stenographer or chief engineer. Public relations and service must both be maintained for the full twenty-four hours of each day. A public relations policy is either a gesture or an honest determination to bring a better understanding between utility and consumer.

* * * *

Publicity That Harms Instead of Helps

PUBLICITY is a very valuable adjunct to anything salable. People must know about the merits or serviceability of an article before they will buy. Hence the reason for advertising. There is another kind of publicity, however, subtler in form and effect than out-and-out advertising, which appears in the reading columns of newspapers and other publications every so often because of its news value or general interest. For example, the smallest lamp in the world, the largest locomotive ever built, the biggest power house, the highest dam, the longest transmission line, will under certain circumstances and conditions receive space in the columns of the daily press. So also will the reports of earnings of large corporations find space in the financial pages of newspapers, together with other items of interest to investors. Experience shows that certain kinds of information have an effect on the market and the prices of stocks go up or down depending on whether the news is good or bad. Sometimes, therefore, facts are perverted with that in view. The blame does not always rest on the company or individual, however, because headline writers in newspaper offices sometimes distort the facts. But it is the company or individual rather than the newspaper that gains or loses by the publicity.

A rather striking example of distortion of this kind affecting the public utility field occurred last week. New York daily newspapers carried this startling headline on September 14: Nine Hundred per Cent Stock Dividend by Pacific Lighting—Utility Declares Big Payment on Common Shares, Which Was Ratified on August 10." The facts given in the text were also glaringly inaccurate. What actually happened was that the Pacific Lighting Company of San Francisco, which controls important gas and electric utility properties in Los Angeles and vicinity, took advantage of the new California law permitting split-up of common stock without change in preferred stock. On September 14 the stock was quoted at 592½ a share on the San Francisco exchange, and the split-up consisted in offering 10 shares of no-par-value stock for one share of $100-par-value stock. When common stock reaches so high a price as $592½ a split-up is

the obvious thing to bring about. But note the distortion and its possible effect on the public mind.

If one should change a ten-dollar bill for ten ones, he certainly would not gain 900 per cent by the operation. Neither did the stockholders of the Pacific Lighting Company, and it is publicity of this kind, for which the company is not to blame, that inflames the public mind against public utility companies because of unheard-of profits. A clamor is set up for lower rates, and the demagogue insists that the public is being robbed. No such charge can be justly brought against the company in question.

* * * *

The Permanency of Change

THE amazingly rapid changes encountered so often by the electric light and power men are still taking place. When one has quite made up his mind that a certain practice is fairly well established, it is high time to anticipate the appearance of a new factor or development. Nothing is constant but change.

Where formerly rotary converters and motor-generator sets were looked upon as the commercially suitable devices for obtaining direct current from an alternating-current supply, the growing influence of mercury-arc rectifiers must now be recognized. There were in 1926 approximately 600,000 kw. of steel-inclosed mercury-arc rectifiers used in all fields of application. This is an increase of nearly 75 per cent over 1925. If installations proceed during the present year at the rate established in recent years, there will be more than 1,000,000 kw. of installed capacity by the end of 1927. More than 400,000 kw. of present installations is devoted to railway service. The explanation given for the increase in use of this apparatus is higher efficiencies and increased reliability. Large users of rectified current, as well as street-railway companies and supplying utilities, may regard with thoughtfulness this growing practice. System and voltage practices in main-line railway electrification may be affected. Old investigations of this type of rectifier may require revision to compensate for recent developments.

* * * *

Economic Values Recognized in Engineering Developments

COST limitations prevent the accomplishment of many desirable results in engineering. Several papers presented at the Institute convention held at Del Monte last week brought out forcibly the importance of economic elements in engineering problems. The protection of oil tanks from lightning fires, for instance, can be accomplished by the use of all-metal tanks, but this is very expensive, and the engineering solution is had by decreasing protection and thereby saving money on the installation of protective schemes. In the protection of transmission lines from lightning it is also evident that a balance must be made between the cost of insulation and the cost of service interruptions. Other examples might be cited. It is encouraging to note that the limits and definite factors needed to balance technical against economic elements are well understood. The trend is to make complete protection the economic solution to these problems.

Oil-circuit-breaker papers and discussions at the meeting were directed toward using breakers as quick-acting relays to sectionalize transmission-line units when trouble occurs. The problem is one of speed and not one of interrupting capacity. Thus a new element is introduced into the already difficult circuit-breaker design problem which is hard to combine with the requirements for large interrupting capacity. A large oil breaker cannot well function as a quick-acting relay.

Other papers and discussions dealt with planning electrical systems on the basis of surveys and studies projected well into the future. Representatives of the telephone industry made many points of value to engineers in the light and power field. Research work on lightning, vacuum switches, machinery and transmission lines was explained which showed that rapid progress is being made toward a complete knowledge of ionization, dielectric and electromagnetic phenomena. One of these days a quantitative and rounded knowledge of electricity will be achieved under the guidance of which engineers may do their work safely and economically. The justification presented at these good Institute meetings for this prophecy is unmistakable.

* * * *

Attacking the People's Savings

ASSAULTS upon public utilities amount to nothing less than attacks on the hard-won savings of millions of men and women. Self-seeking politicians and demagogues will make these attacks at their peril, once the public grasps the connection between such agitation and the credit of those essential enterprises which are today so largely built upon the dollars of the small investor. It is well known within the electrical industry that enormous sums deposited with life insurance companies, savings banks, trust organizations and agencies are at work in the maintenance and development of electrical service in all its forms, but it is vitally important that the public at large shall realize its stake in the utility field.

When an ambitious politician establishes an office and broadcasts an apparently limitless amount of "bunk" about a non-existent national electric power monopoly and seeks to discredit the achievements and motives of a great and honorable industry, he is assaulting the savings of millions of people, even if the immediate effect of any particular tirade is as widely scattered as the output of an individual transmitting aërial.

It is the duty of the light and power industry to see to it that the local publics throughout the country understand the animus of the demagogue when such attacks reach a point where to ignore them may lead the people to assume that they have some basis of truth. No industry representing many billions of dollars invested is beyond all criticism, but the moral health of the electrical business is so high in tone that every right-minded and intelligent person in it should resent unfair attacks, whether in Congress next winter or elsewhere. For years the utilities have been telling their story with increasing effectiveness to the public at large through progressive management, information bureaus, better-trained employees, improved service and decreasing prices. Customer ownership has made tremendous headway and now exerts a political power little realized by the unscrupulous agitator. The task, however, is as perpetual as that of maintaining bodily health through sound living and progressive mental habits. We have become a nation of investors, and the responsibility for safeguarding John and Mary's savings now falls in part upon

our own industry and increases daily. There are many avenues of defense against unwarranted attacks upon this industry, but when the time comes to traverse these, let us not fail to include this one in our journey as we go forward to meet the enemies of private initiative and thrift who seek to discredit one of the soundest enterprises ever created for the benefit of mankind by trying to hoodwink the people into government ownership.

* * * *

The Industry Ties in with the Reorganized S.E.D.

NO MEETING held in the electrical industry in recent years has set a more notable milestone than the first gathering of the reorganized directorate of the Society for Electrical Development last week. It marked the triumph of an ideal that has been struggling for acceptance for fourteen years. For it was in 1913 that, under the inspirational leadership of J. Robert Crouse, the long-discussed idea of establishing a co-operative institution for the development of the electrical market took tangible form in the organization of the S.E.D. And from that time to this the society has waged an uphill fight against an almost continual discouragement that would have long since brought defeat but for the loyal and persistent support of that sturdy little band of directors who have refused consistently to have that ideal counted out.

The reasons for all this trouble are easily written. The war came within a year, and market development was first not needed and then frowned upon. Then through unfortunate administration the society became gradually embroiled in various ways with other groups within the industry, and credit for much good service rendered was sacrificed to criticism. Always there was a fundamental weakness in that the S.E.D. was a loose-pulley operation. With no orderly relationship to the organized industry, co-ordination was impossible. Finally came acute financial embarrassment, and the industry thought that the S.E.D. was done. But in the short space of nine months, through the genius and courage of W. W. Freeman, a complete reorganization has been effected.

The society has now been officially tied in with all the major national associations of the industry and with the leagues. The presidents and managing directors of these organizations sit on the society board, so that industry co-operation becomes automatic. This board now provides an informal council of the industry where the men responsible for the national association work will also be responsible for the co-operative development of the industry. Meanwhile through a bond issue the society has been refinanced and starts the new era with all debts paid and money in the bank. The appointment of Kenneth A. McIntyre as managing director ends the long uncertainty as to who is to head the staff. It should give general satisfaction. Much of the future work must be done through the leagues. No man has done more for league development than he. His long experience through the vicissitudes of recent years has been splendid training for the job.

The industry should be tremendously encouraged. The new directorate has taken hold with energy and purpose and the work should go forward promptly. The society is now entitled to the confidence and support of every electrical man and company.

The Mechanics of Cable Failure

CAUSES of the failure of the dielectric of cables properly to insulate the conductors in the cable from each other and from ground provide a subject that calls eagerly for research. In this number of the ELECTRICAL WORLD Luigi Emanueli of the Pirelli Cable Company relates most enlightening observations made in his laboratories. Signor Emanueli has observed the importance of the quantity of occluded gases in the dielectric as it affects the susceptibility to failure of the cables. Gases, in a cable subjected to a high potential, are readily ionized by the electrostatic field and, with the impregnating compound, form emulsions of extreme turbulence. In addition the electrostatic field forces the gas through the paper of the dielectric, creating a path of reduced resistance which leads ultimately to the failure of the cable. The influence of the electrostatic field upon the insulating oil itself is demonstrated in the same series of experiments.

Cable joints, cable structure, methods of installation, duct lines and trench placement have all received attention and have been the subject of innumerable experiments, but there is also needed the viewpoint of the research man, the logic of imagination.

The growth of our urban communities, the use of high potentials and the increasing demands of our complex civilization will require the use of more cable for use with high voltages, and the need for improved, usable information on this subject is great. Signor Emanueli has contributed widely to the augumentation of understanding. Now arises the demand for more laboratory work and more clear engineering thought on this important subject.

* * * *

More Data on Electric Water Heating

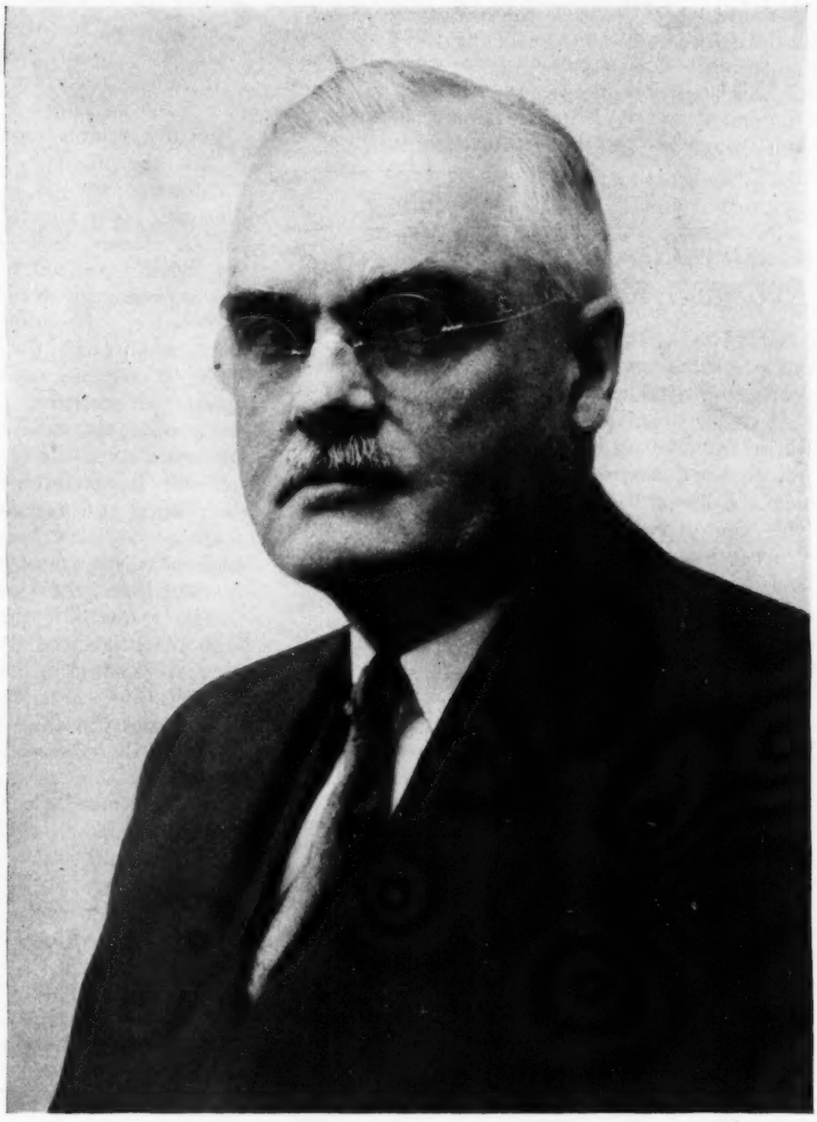
ALL power companies are intensely interested in any electrical appliance that can be sold to residential customers and thereby broaden the use of electric service in the home. The electric water heater is probably the heaviest energy consumer which it is practicable to offer domestic users, and a number of companies have found this a profitable load. Others are asking for more data. The tests which are to be conducted in California by the water-heating committee of the N.E.L.A. Commercial Section are therefore extremely important to all electric utilities. These tests will be supplemented by individual company investigations carried on in other sections of the country to determine the effect of different climatic conditions and thereby afford a basis for comprehensive comparison.

Benefiting by experience gained in the range survey, W. C. McWhinney, chairman of the water-heating committee, has mapped out a very definite program of tests which will provide all of the essential information necessary to an intelligent study of this load. Tests will be conducted on high-wattage and low-wattage heaters, manually and automatically controlled, the use of throw-over switches and peak limiters and different combinations of these.

From these data it will be possible to determine the type and size of electric water heater which should be recommended for a given service, the effect of the load on the system and what rate should be offered to get the business.

Harold Babbitt Smith

Electrical engineer and educator, whose quest of the unknown has inspired both practitioners and students for more than a generation.



TO SERVE with distinction in engineering education, practice and research from the outset of one's professional career is a privilege built on great exactions. When such service is rendered by an engineer with the untiring enthusiasm of the scientist, its influence passes beyond methods of measurement. For a generation and over Prof. Harold B. Smith, director of the department of electrical engineering at the Worcester Polytechnic Institute, has exemplified a triple leadership in investigation, practice and education which has won him high regard in professional circles and an honored reputation as a pioneer in high-voltage and dielectric technique.

Professor Smith was born in 1869 at Barre, Mass. He received an M.E. from Cornell University in 1891 and after two years of post-graduate study and teaching, with a period of engineering work for the Elektron Manufacturing Company of Springfield, Mass., became professor and director of the department of electrical engineering at Purdue University in 1893. In 1896 he was placed in charge of the corresponding department at Worcester. Since 1905 Professor Smith has served the Westinghouse company as electrical engineer, designer and consultant. He has carried on a long series of engineering researches in the high-voltage field, including pioneer construction of ultra-potential power transformers and insulators embodying advanced conceptions of dielectric phenomena and stress distribution in design. His backing has helped to push along important high-tension developments in the Westinghouse organization, and his support has constantly been of value to progress in the field of solid dielectrics.

A member of many learned societies interested in engineering, science and education in America and abroad, Professor Smith is a fellow, past director and past vice-president of the A.I.E.E., besides being chairman of the sections committee. During the World War he was an associate member of the United States Naval Consulting Board and consulting engineer with a special naval board on anti-submarine devices. In 1904 he headed the group jury of awards in electrical engineering at the Louisiana Purchase Exposition. His contributions to the literature of science and engineering include important A.I.E.E. papers and monographs before other organizations.

Gas Films in High-Tension Cables*

Tests show that bombardment of compound by gaseous ions causes air emulsion and forces path through impregnated paper fiber, leading eventually to dielectric breakdown

By LUIGI EMANUELI
Chief Engineer Pirelli Company, Milan, Italy

THE seriousness of gas films in cable dielectric and the fact that a rise in temperature may very noticeably increase the volume of gas trapped in the cable have been demonstrated before.[1] The latter may be readily understood by keeping in mind that the insulating compound, when it expands under increasing temperature, forces the lead sheath outward, thus increasing its diameter. With subsequent cooling and contraction of the compound, the diameter of the lead sheath does not decrease, owing to the nature of this metal, which is more viscous than elastic.

One method of detecting the quantity of gas trapped in a cable, or at least of gaining an idea of the effects produced, involves measuring the change in power factor with different voltages. At room temperature and with gradients which are not too high, the dielectric used in high-tension cables (paper, impregnated with insulating compound, mostly mineral oils) gives a power factor practically independent of the applied voltage. However, if some films or bubbles of gas are occluded in the insulation, the power factor increases when the ionization voltage is reached and the change with voltage may provide the means of calculating the energy lost in the gas films.

Practically all mineral oils have a cotangent ϕ which is nearly constant[2] at low temperatures, but which at temperatures above 50 to 60 deg. C. increases sharply with the applied voltage; the higher the temperature the

*Translation of a paper presented to the First Congress of the Union Internationale des Producteurs et Distributeurs d'Energie Electrique. Further study and more experiments are being made by the author on this subject, which is of the greatest importance in cable life.

[1] L. Emanueli, *L'Elettrotecnica*, Vol. 9, page 606, 1922.

[2] L. Emanueli, Conference Internationale des Grands Reseaux Electriques, Paris, 1925. Communication No. 64.

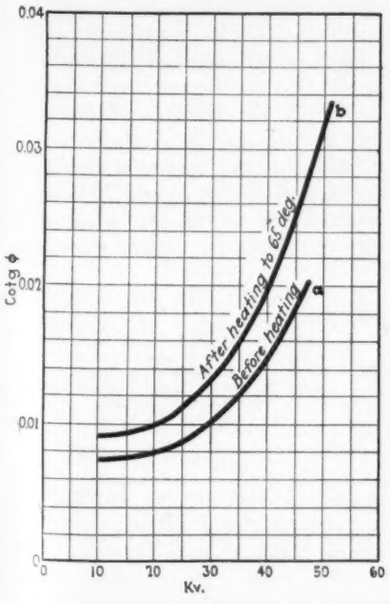


FIG. 1—CHANGE OF DIELECTRIC PHASE ANGLE WITH VOLTAGE

1. Curve *a* refers to the cotangent ϕ of a three-conductor cable at 17 deg. C with one conductor energized and the two other conductors and the lead sheath grounded. The constant part of the curve is attributable to the dielectric viscosity of the solid part of the insulation; the variable part is due to the gas films. The second part is a function of the previous history of the cable. Curve *b* gives cotangent ϕ for the same cable after heating up to 65 deg. C.

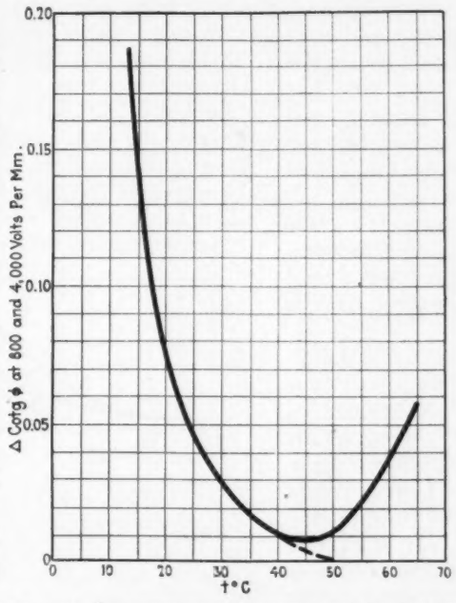


FIG. 2—DIFFERENCE BETWEEN PHASE ANGLES AT TWO GRADIENTS

2. The difference between cotangent ϕ at 4,000 volts per millimeter (average) and that at 800 volts per millimeter (average) for a three-conductor cable is indicated. It is assumed that at 800 volts per millimeter the cotangent ϕ should have the same value as for very low tensions. At low temperatures the difference of cotangent ϕ reaches a very high figure; it diminished with increasing temperatures, because the compound expands and thus compresses the gas films. The gas, at higher pressure, is ionized only at higher voltages, and with the same gradient gives smaller energy losses. The volume of gas

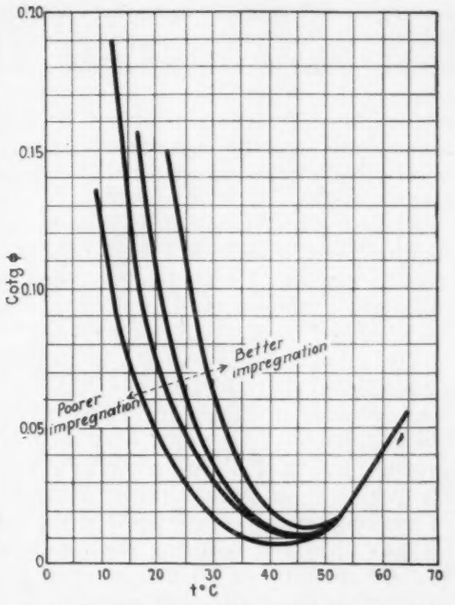


FIG. 3—POWER FACTOR VARIATION WITH QUANTITY OF OCCLUDED GAS

diminishes also, for the reason that it goes into solution in the compound. The energy losses caused by the ionization of the gas have a tendency to be reduced to zero. The curve of the change in cotangent ϕ would pass through zero following the dotted line if other phenomena, due to the compound and not to the gas, did not take place.

3. Changes of cotangent ϕ for several cables having the same kind of insulating compound, but with different degrees of impregnation or occluded gas are shown by the accompanying curves.

sharper the curve. For this reason, above 50 deg. C. the curve of the change in cotangent ϕ (Fig. 2) increases with higher temperatures. The shape of the curve is thus V-shaped, with a minimum at about 50 deg. C. The first part, which corresponds to lower temperatures, depends almost wholly upon the quantity of air distributed through the dielectric, and varies with different cables, depending upon the degree of saturation. The second part, above 50 deg. C., is generally dependent upon the quality of the compound, and is virtually constant for cables manufactured in the same way.

All that has been mentioned with regard to the cotangent ϕ applies only to rapidly rising temperatures.

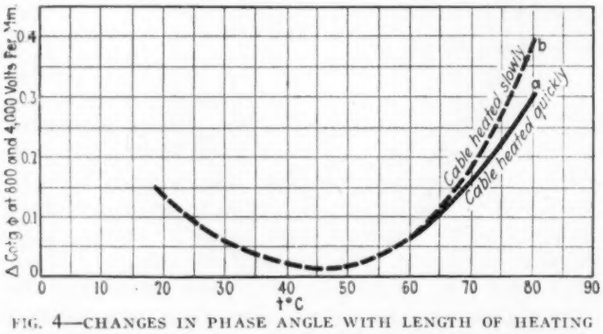


FIG. 4—CHANGES IN PHASE ANGLE WITH LENGTH OF HEATING

Increase of cotangent ϕ when gradient is raised from 800 to 4,000 volts per millimeter (20 to 100 volts per mil) as a function of the temperatures: (*a*) for a cable heated up quickly; (*b*) for a cable heated up slowly.

If, instead, the cable is submitted for a long time to high temperatures the change in the cotangent increases to a value which afterward remains quite constant. This appears to be due to the fact that with an increase of temperature and consequent increase in volume of the compound the pressure in the gas films increases sufficiently to force them into solution with the compound. The pressure deforms the sheath very slowly and thus decreases slowly, so that the gas is released from the compound. After a long enough period of time has elapsed the pressure should not be much greater than atmospheric and the volume of free gas should be very nearly that of the gas in the dielectric at the low initial temperature.

Assuming the explanation given to be correct, a cable that has been heated for a short time should not be damaged as much as a cable that has been heated for a long time, when brought back to a low temperature. This is corroborated by data plotted herewith.

The volume of gas that can be entrapped while manufacturing an extra-high-tension cable of the usual type was determined during the construction of a cable of the hollow-core type, filled with fluid oil.[3] Hydrostatic pressure was applied at the end of a length of this cable, the pressure being transmitted along the hollow center of the conductor to every point of the cable, compressing the gas films and reducing their volume. It is evident that the quantity of oil that must be added to the cable to increase the hydrostatic pressure is the same as the decrease in volume of the gas bubbles, and that, if the amount of this decrease is known, the total volume of gas in the cable when it is at working pressure may be computed. The necessary corrections must be made to allow for the elastic expansion of the lead sheath, which is not small.

The first interesting conclusion derived was that the volume of gas in the cable is proportional to the change in cotangent ϕ. In the type of cable in which the test was made it is possible to have nearly perfect impregnation. The data given were obtained when conditions had purposely been made worse than usual. To secure an idea of what happens in usual types of cable, it is necessary to make an extrapolation of the straight line of Fig. 7 and to calculate the quantity of gas from the value of the changes in cotangent ϕ, which are usually measured. This extrapolation leads to the conclusion that the usual volume of gas occluded in the dielectric at a temperature of 20 deg. C. amounts to a value of between 0.5 and 1.5 per cent of the total volume of the dielectric. The smaller figure corresponds to cables with a small diameter; the larger to cables with a large diameter.

What happens in the gas bubbles distributed through the insulation is not well known, and it is probable that no theory exists that may clearly explain how the presence of gas films causes, in many instances, the breakdown of the cable. It is also probable that the phenomenon follows more than one law.

Compound Affected by Ionized Air

It has never been demonstrated that the charring of the surfaces between which the gas bubbles are trapped is due to the energy losses in the bubbles. Tests made with high frequency to dissipate a greater amount of energy in the gas bubbles, under ionization, have given negative results.

In an effort to explain this phenomenon, I have tried to reproduce it in the following way:

A glass container, full of water, was put on a glass plate standing on a metal plate (Fig. 8). Between the metal plate and the water in the container (corresponding to the plates of a condenser) an alternating voltage was applied. Before putting the container on the glass plate a film of the compound used in the impregnation of the high-tension cables was applied on the glass plate. The container was put in place in such a way as to leave a bubble of air in the center of the surface of contact between the plates and the bottom of the container. A close observation of the bubble could be made through the water of the container, and a picture could be easily taken by removing the metal electrode on the bottom.

Accompanying illustrations show the appearance of

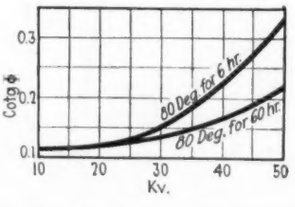


FIG. 5

Power factor versus voltage with short and long periods of heating. Cotangent ϕ as related to changes in voltage at 23 deg. C for a cable heated to 80 deg. for six hours (upper curve) and for 60 hours (lower curve).

an air bubble viewed perpendicularly to the water surface of the container after applying a gradually increasing voltage. The bubble is ionized and becomes the center of the well-known glow light. At a voltage only slightly greater than the ionization voltage the insulating compound is violently shaken and a great number of small air bubbles are mixed up with the compound, producing a sort of foam or emulsion of air and oil.

Bubbles Projected Through Insulation

This transformation of the bubble (which, in this instance, because of the presence of the glass surfaces, was allowed to expand only in the direction perpendicular to the electrostatic field) suggested the idea that there

[3] L. Emanueli, *L'Elettrotecnica*, Vol. 12, page 18, 1925.

might have been some expansion of the air in the direction of the field if a porous material had been used instead of glass. Tests showed this hypothesis to be correct.

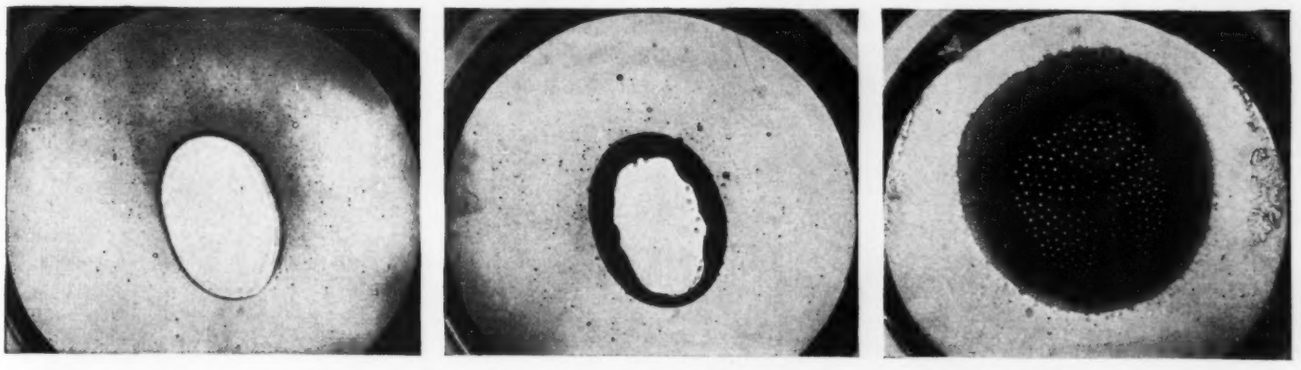
The glass plate of the preceding experiment was replaced by a composite dielectric consisting of several sheets of well-dried paper impregnated with insulating compound. Great care was taken to avoid gas occlusions. On the layer, covered with a thin coat of insulating compound, the glass container was set, as in the first test, in such a way as to have a bubble of air trapped between the bottom of the container and the upper surface of the layers of compounded paper. When the tension was applied between the two electrodes, the effect observed through the water of the first electrode was exactly the same as in the first test. After the voltage had been applied for a considerable period and the air bubble had been transformed into a larger one composed of very thin foam, the glass container was taken away and the foam covering the layer of paper was removed. By looking at the paper against the light, it was possible to see some small gas bubbles under the first paper sheet in a position corresponding to the upper large bubble of foam. When the first layer of paper was removed, a few bubbles were observed between the second and the third sheet under the large bubble. It was then figured that if the gas found between the layers was the air contained in the upper bubble, which had been pushed through several layers, the phenomenon would have been produced in a much quicker and easier way, by using a porous paper impregnated with fluid oil, which would not occlude too much air in the pores of the paper.

A third test, using filter paper impregnated with transformer oil, was then made. In this instance, too, a great quantity of small gas bubbles was found under the first and the second paper sheets after a few moments of applied voltage, thus confirming the anticipations. Because of the great fluidity of the oil, the bubble included between the bottom of the container and the upper surface of the paper layers was very movable and, as a result of the shaking produced by the applied voltage, the bubbles under the different layers of paper changed continually in position. It was thus proved without any doubt that the air forming the upper bubble was forced gradually through the sheets of paper in the direction of the applied electrostatic field.

This experiment seems to give an explanation of another one that was made in the same laboratory a long time ago. The latter was very similar to the second one hitherto described, with the difference that instead of stopping the test after a short period of time to observe if the air were passing through the first layer of paper, it was continued for a long time with the purpose of observing the air bubble through the water of the container. In this instance a small stain was observed on the surface of the paper layer at a point included in the air bubble, just as if the compound had been projected from the paper sheet at this point. After a certain time the point became bright and an electric discharge started from it, branching out in a tree-shaped figure on the bottom of the container. When the voltage was kept on, the discharge always became brighter, and a second shining point, not very far away from the first one and connected with it by branched discharge, was observed in transparence between the first and the second sheet.

In a few instances, after a certain length of time, it was possible to observe still another bright spot of light at a point that seemed to be lower but near the first two. The brightness and the tree-shaped discharge in the air bubble under the container increased rapidly, and finally the glass was punctured. If, instead, the test were stopped immediately after the brightness showed in correspondence with the black stain, it was noticed that the paper sheet had, in that point, a small pinhole, which could be detected only with a strong lens and which had no traces of scarring. The probable explanation of this last test may be given from the results of the first two. The air of the bubble is carried through the paper sheets for the most part, and probably only through those points that allow an easier path, due to the greater local porosity. This path becomes gradually easier, due to the fact that the compound, which fills the pores of the paper, is carried along by the molecules of the gas. In this way a bubble is formed under the first paper sheet, and in a similar way passes through to the second, the third, and so on. There is no doubt that the paths through the various sheets of paper need not coincide.

The stream of gaseous ions that passes through the path opened in the first layer of paper finds a barrier in the second layer. The stream pushes away and makes, all around, an emulsion of the compound, thus creating a gas film between the first and the second layers. A point more permeable to the compound is, in a way, "searched" for on the second layer. As soon as this point is found, the bombardment of gaseous ions pushes away the compound, and when the path is made still more permeable, the gas is pushed between the second and the third layers, and so on. The pinholes found in the paper are probably due to the breaking of the fiber



FIGS. 6, A, B AND C—AIR BUBBLE ON FILM OF COMPOUND AFTER BEING SUBJECTED TO 45 KV. FOR ONE, 45 AND 420 MINUTES RESPECTIVELY

The less transparent foam caused by the electrical agitation of the compound comes out black in the illustration. The bubble shown was slowly changed by the applied voltage into a much larger one composed of an emulsion of very small air bubbles suspended in the insulating compound.

barriers by the gaseous ions. If, by extending itself in the direction of the field, the dissipated energy increases, such a temperature can occur as to produce the bright points observed, and those tree-shaped carbonizations which, in cables, are so often noticeable at points near a failure.

Electrostatic Displacement of Compound

Tree-shaped carbonizations in cable insulation have been reproduced only in a few of the tests made. In all of them, however, after the condenser plates had been taken apart and the paper sheets carefully removed, one from the other, signs of the discharges on the paper were noticeable at the points where the tree-shaped discharge had been observed by transparence through the paper. It appeared as though the layer of compound on the paper had been carried away all along the surface followed by the discharge.

This last phenomenon does not seem to be due to heating, but instead to the fact that the compound is carried away by the ions of the gas, as shown in the following test, which can be easily made. An alternating electrostatic field is impressed between a needle and a metal plate separated by about ten sheets of paper, impregnated with a heavy compound such as that used in high-tension cables. The surface of the paper is only a few millimeters from the needle. As soon as the voltage is applied, the layer of compound on top of the first paper sheet is blown all around just as though a stream of air were coming out from the needle. The compound is also pushed out of the spaces between the paper fibers, being carried away most energetically where the stream coming out from the needle is greatest.

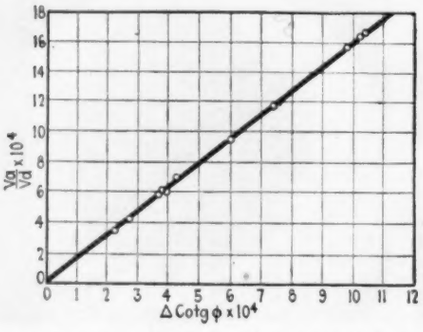


FIG. 7—DIFFERENCES IN POWER FACTOR VARIATION WITH QUANTITY OF OCCLUDED GAS

The abscissas give the difference in cotangent ϕ from an average gradient of 4,000 volts per millimeter to 800 volts per millimeter. The ordinates give the ratio between the volume of the gas and the total volume of the dielectric.

Puncture, under the action of an alternating field, seems to be produced by gaseous ions from the needle bombarding and pushing aside the compound on the surface of the paper under and around the point; then, little by little, the ions enter the various layers, choosing the mechanically easiest passage and thus creating some canals through which the compound is substituted by the gas projected by the needle. The barriers made by the paper fibers are turned around or destroyed little by little by the ionic bombardment. The discharge resulting from gaseous inclusions in the insulation of a cable seems to be due to the bombardment by gaseous ions and subsequent propagation of them through the dielectric, following the paths of smallest resistance. This applied to the barriers made by either compound or paper fiber, the latter being the stronger. This phenomenon explains the tree-shaped carbonization and also the effect of time of overvoltage application.

The tests have shown, without any doubt, that the greater the dimensions of the gas bubbles in the direction of the electric field the more conspicuous are the phenomena mentioned. A very thin film requires a much higher voltage gradient than a thick one to produce a gas emulsion or force the gas through the paper. Therefore it is very probable that a critical voltage gradient should exist, depending upon the thickness of the gaseous bubbles. The probability of a critical gradient would explain why high-tension cables are working perfectly at higher voltages than that required to reproduce ionization.

The foregoing phenomena also afford an explanation of why the single-conductor cable gives better results

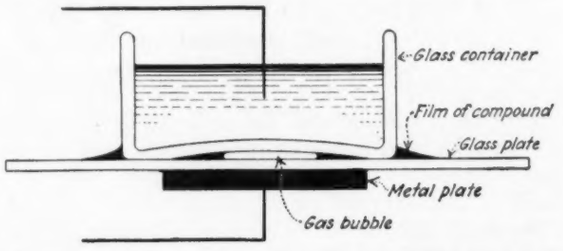


FIG. 8—ARRANGEMENT OF APPARATUS FOR STUDYING EFFECT OF GAS BUBBLE IN COMPOUND UNDER VOLTAGE STRESS

than the three-conductor cable. In the latter type, it is very easy to find relatively large voids because, due to the larger diameter, it is easier to have wrinkles in the insulation when bending the cables. Furthermore, the three conductors forming the cable may move with respect to one another, thus increasing the empty spaces between the cores and the fillers. The success of three-conductor cables having the conductors covered with a metallic layer is probably due to the fact that the formation of empty spaces along the surface of the paper layers is not dangerous, as they are out of the electrostatic field. When tangential stresses are present in a cable, they may affect some gas films occluded between layers of paper just along their greatest dimension, and thus produce tree-shaped discharges, which will move between the various layers without finding any barrier. This happens particularly in joints.

It is evident that something must be added regarding the quality of the insulating compound used to impregnate a cable. If the compound is rather viscous, it is difficult to move it; and it represents a good barrier

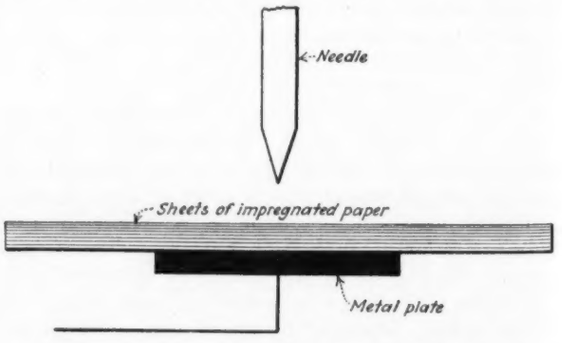


FIG. 9—ARRANGEMENT OF ELECTRODES AND MATERIAL FOR TEST OF DIELECTRIC DISPLACEMENT

against the bombardment of gaseous ions. If the compound is liquid, it may be easily pushed away, but it has a tendency to refill the paths that may have been formed through its mass. From this may come the explanation of the much better results which the fluid oils rather than viscous compounds seem to give when used in cables and in joints.

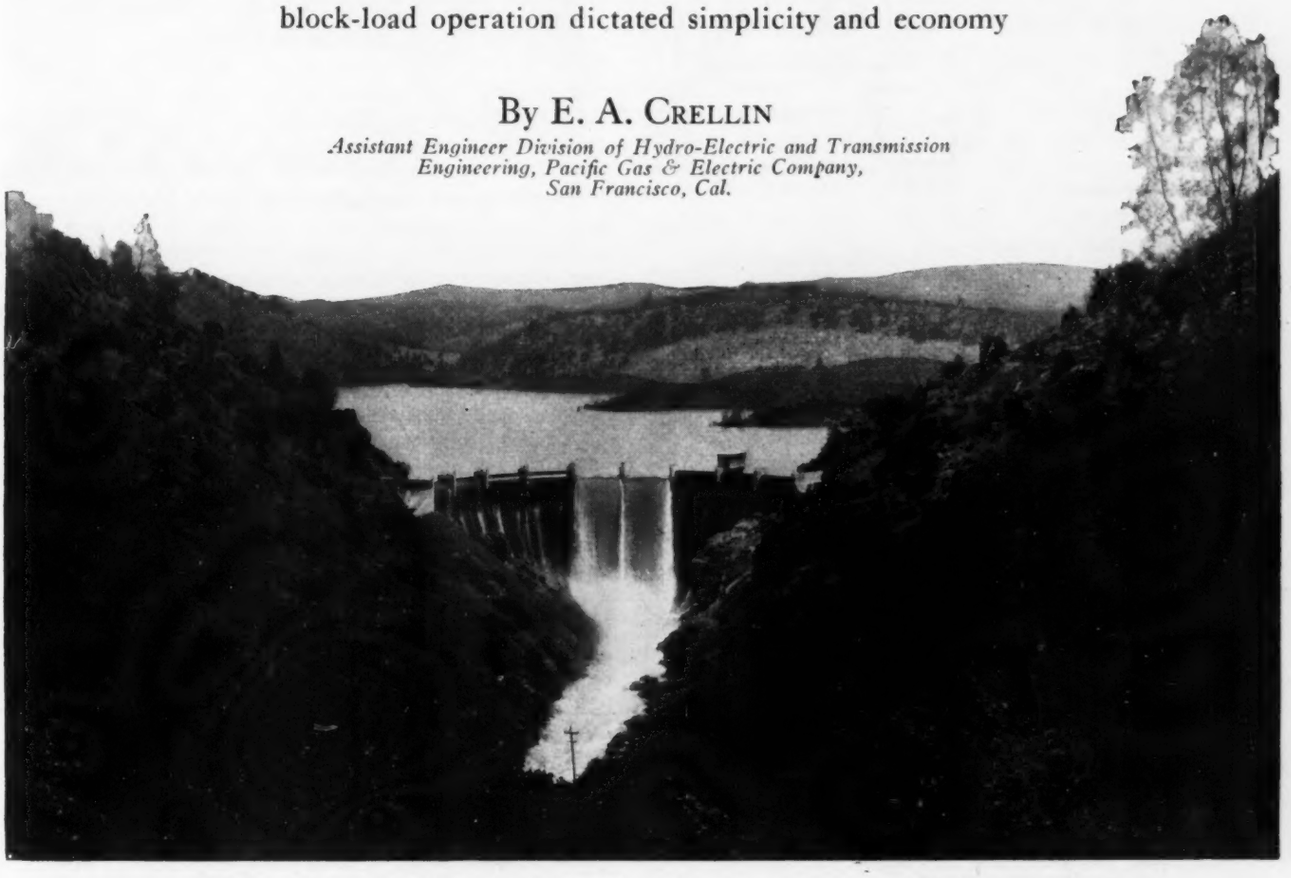
Power and Irrigation Combined

in Melones Development

Pacific Gas & Electric Company builds power plant and pays irrigation districts' water rental. Low load factor and block-load operation dictated simplicity and economy

By E. A. CRELLIN

Assistant Engineer Division of Hydro-Electric and Transmission Engineering, Pacific Gas & Electric Company, San Francisco, Cal.



MELONES DAM ON THE STANISLAUS RIVER, CALIFORNIA, IS USED FOR BOTH IRRIGATION AND POWER

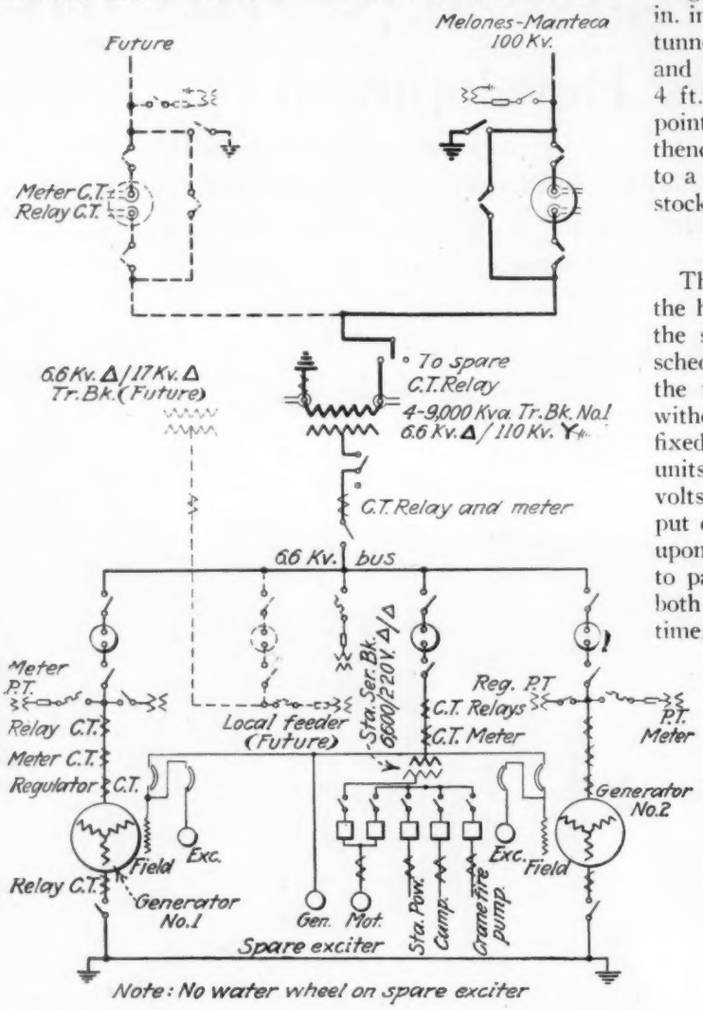
THE Melones power house of the Pacific Gas & Electric Company on the Stanislaus River about 10 miles from Sonora, Cal., is a part of a combined hydro-electric and irrigation project undertaken jointly by two interests—the Oakdale and South San Joaquin Irrigation Districts and the Pacific Gas & Electric Company, successor to the Sierra & San Francisco Power Company. Such a joining of forces makes for the best possible economic use of natural resources, to the mutual benefit of all concerned. It gives to the irrigation district the full financial benefit of its electrical by-product without diverting any capital from its primary object and has the further advantage that it does not divert the attention of the irrigation directors from their primary problem.

The irrigation districts have built the Melones dam at a cost of $2,200,000 to store 112,000 acre-ft. of water, while the Pacific Gas & Electric Company expended $2,500,000 for a power house, which will utilize the impounded water. The power company has agreed to pay the irrigation districts for the use of water a total sum of $5,175,000 serially over a period of 40 years, or approximately $130,000 annually, which is sufficient to pay interest on the districts' bonded indebtedness and retire the investment at the end of the 40-year period. The power company has agreed to allow the districts free use of the water now stored by the company, amounting to 35,000 acre-ft., in two reservoirs higher up on the stream and whatever additional water it may store in the future; plans are now under way for the creation of 60,000 acre-ft. of additional storage. The districts will control the river flow from March 1 to Nov. 1 and the power company will control it the remainder of the year.

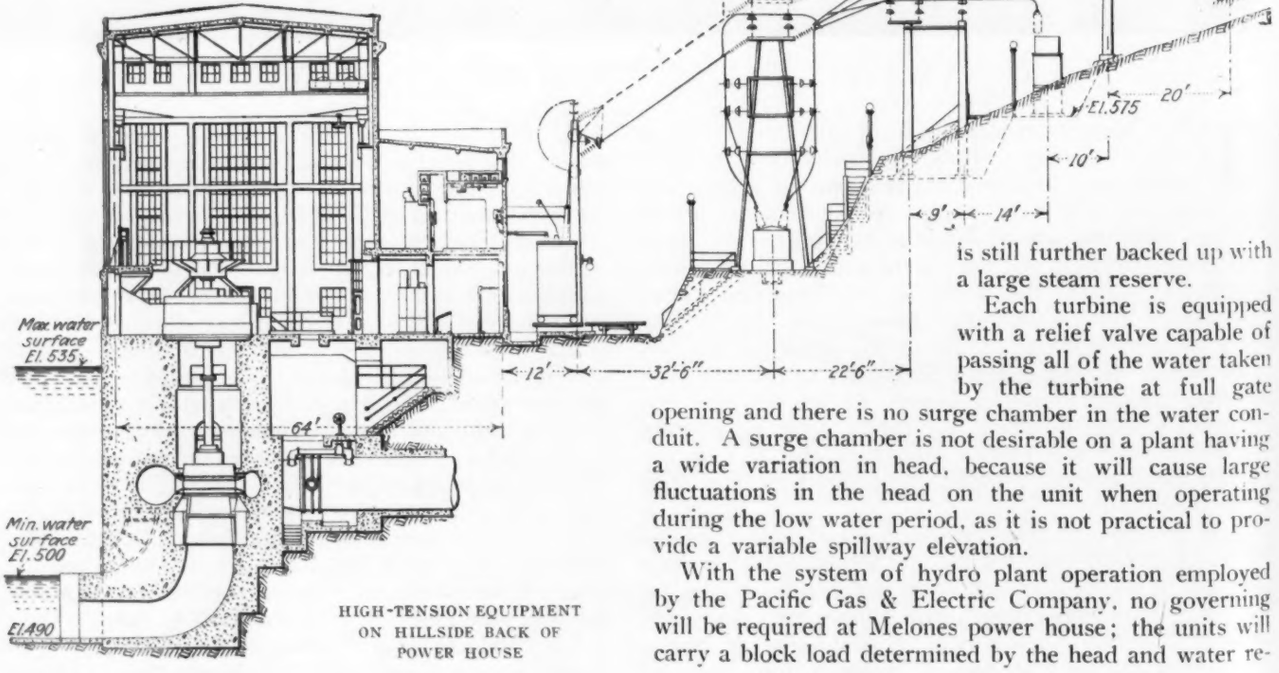
The Melones dam is of the constant radius arch type, 191 ft. high, with a crest length of 591 ft. The irrigation outlet is located approximately 400 ft. below the dam and consists of four 60-in. Pelton balanced needle valves. Spillway capacity for double the maximum recorded flood of 60,000 sec.-ft. was provided by nine drum-type spillway gates, each 12 ft. high by 57 ft. long.

The Melones power house is constructed of reinforced concrete and steel and houses two 17,900-hp.

vertical turbines, which will operate under a head ranging from 235 ft. to 140 ft., depending upon the amount of water in the reservoir. The turbines are direct connected to two 13,500-kva. generators. Construction work was taken up by the power company just below the irrigation outlet, at which point a butterfly valve 11 ft. 6 in. in diameter was installed in the pressure tunnel. The tunnel is of concrete-lined horseshoe section 12 ft. high and 12 ft. maximum width and is carried on a slope of 4 ft. per 1,000 ft. for a distance of 4,145 ft., at which point it drops 83 ft. in elevation on a 1¼ to 1 incline, thence continuing on a level grade approximately 300 ft. to a concrete manifold, from which two 8-ft. 6-in. penstocks lead to the turbines.



SWITCHING AND BUS ARRANGEMENTS AT MELONES POWER HOUSE



HIGH-TENSION EQUIPMENT ON HILLSIDE BACK OF POWER HOUSE

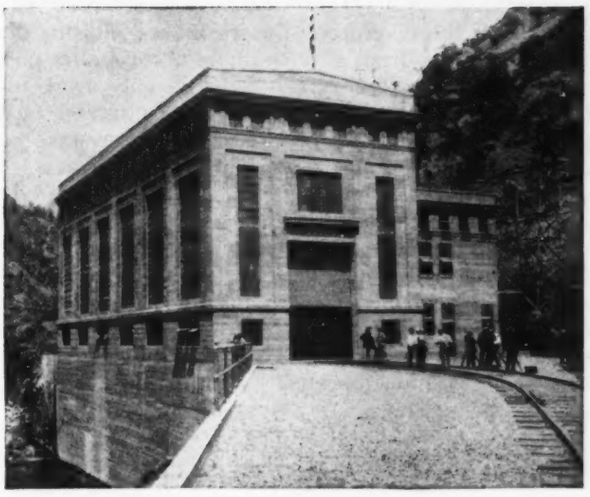
Generating Equipment

The choice of generating equipment was governed by the hydraulic conditions and the relation of the plant to the system to which it is connected. The water-flow schedule required by the irrigation districts, coupled with the variable head encountered as the storage water is withdrawn, predetermined the annual plant output and fixed the generating capacity at about 27,000 kva. Two units were installed, each rated at 13,500 kva., 6,600 volts, 277 r.p.m., 0.90 power factor. The kilowatt output of the plant will vary over a wide range, depending upon water conditions, but inasmuch as it is necessary to pass the water through the plant for irrigation uses, both units will be in operation a large percentage of the time, even at reduced heads.

The annual load factor of the plant will be low. For this reason no spare generating capacity has been installed as insurance against shutdowns for repairs or to carry peak loads. This lack of standby capacity is further justified by the fact that the plant with its 27,000 kva. of installed capacity represents only 6.5 per cent of the installed hydro-electric generating capacity of the Pacific Gas & Electric system, which is still further backed up with a large steam reserve.

Each turbine is equipped with a relief valve capable of passing all of the water taken by the turbine at full gate opening and there is no surge chamber in the water conduit. A surge chamber is not desirable on a plant having a wide variation in head, because it will cause large fluctuations in the head on the unit when operating during the low water period, as it is not practical to provide a variable spillway elevation.

With the system of hydro plant operation employed by the Pacific Gas & Electric Company, no governing will be required at Melones power house; the units will carry a block load determined by the head and water re-

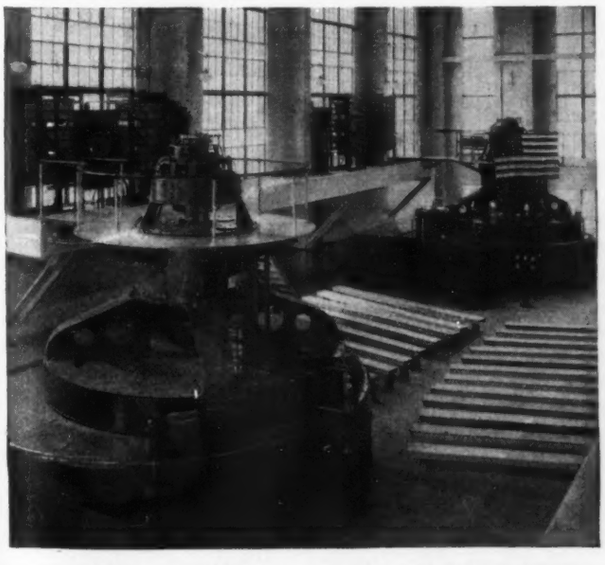


RECENTLY COMPLETED PLANT OF PACIFIC GAS & ELECTRIC COMPANY

quirements for irrigation purposes. The relief valves are arranged for convenient conversion to synchronous bypass valves and will permit the plant to govern should it ever become necessary to operate it isolated from the rest of the system. In a plant supplying water for irrigation, the water-wasting nature of a synchronous bypass valve is unimportant, as the water must be fed into the stream to meet the irrigation requirements.

The entire policy governing the design of the plant was simplicity and convenience of arrangement, coupled with low cost of installation. The two generating units feed a single bank of three 9,000-kva. transformers, which step the voltage up to 110 kv. for feeding into the 110-kv. transmission network of the system. A spare transformer is so arranged that it may be switched in to replace any unit requiring inspection or repairs. It was found that, in addition to affording a more simplified arrangement, the single bank of large transformers had a higher efficiency at half load than the smaller transformers would have at full load, which was a further justification for the single bank.

The entire arrangement of the plant lends itself to convenient operation. The possibility of high tail-water during the flood season made it necessary to place the generator floor well above the turbine floor, and for that reason all parts requiring frequent attention are on the main generator floor convenient to the switchboard room, making it unnecessary for the operator to visit the lower floors except for periodic routine inspection and oiling.



TWO 13,500-KVA. GENERATORS IN MELONES POWER HOUSE

Undervoltage Protection

By D. W. McLenegan
Industrial Engineering Department,
General Electric Company

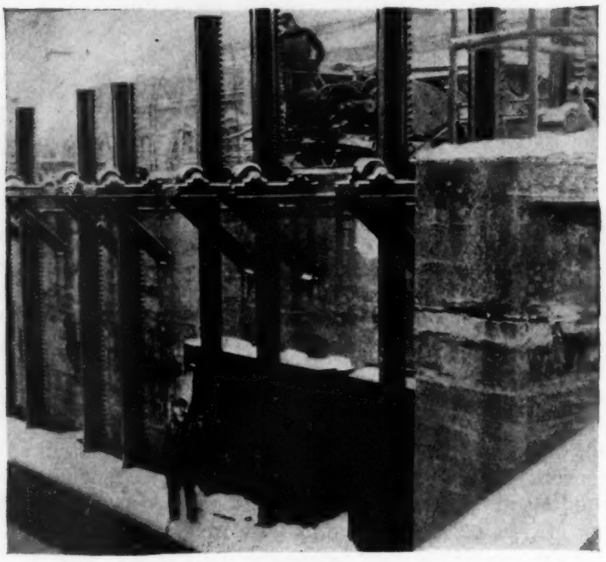
MANY industrial plants are troubled by synchronous motors dropping out of step because of occasional severe variations in the supply voltage. Since these voltage dips are usually of very short duration, of the order of one second, there has been a tendency to use the time-delay push button on synchronous motor starters, with the expectation of eliminating the interruptions caused by undervoltage. The time-delay push button used with synchronous motors will undoubtedly prevent many shutdowns now experienced where instantaneous undervoltage releases are used, but it will not always be as effective as with induction motors.

Two conditions must be considered in using time-delay undervoltage devices with synchronous motors:

1. If the voltage drop is not of sufficient magnitude or duration to throw the motor out of step when operating with load, a time-delay undervoltage device will function as advantageously as it does when used with an induction motor. The time-delay undervoltage relay will avoid the interruptions that are caused by instantaneous undervoltage relays opening the circuit at too high a voltage.

2. If the voltage dip is sufficient (slow-speed motors, approximately 35 per cent voltage drop; high-speed motors, approximately 50 per cent voltage drop) to throw the motor out of synchronism, conditions are changed. Assuming that a time-delay undervoltage device is used to keep the line switch closed during a brief voltage fluctuation, the return of normal voltage will find the motor operating below synchronous speed, but with full excitation. The excitation circuit remains closed, because the field switch is either manually operated or is of the contactor type, which opens only at very low voltages. In general, high-speed synchronous motors will develop sufficient torque on the squirrel-cage starting winding to pick up speed and resynchronize within a few seconds. However, a heavy pulsating current will be drawn from the line while the motor is operating at reduced speed with full excitation. The resynchronizing can be made easier if the excitation is temporarily cut off. The slow-speed motors (for air compressors, ammonia compressors, Jordan drives, etc.) will merely stall, since the torque developed by the squirrel-cage windings is comparatively low. Such motors can return to synchronous speed, after dropping out of step due to undervoltage, only if both the excitation and the load are removed. Relays are available for taking off the excitation. The load also can be automatically removed in a few cases such as air compressor drives, but automatic unloading valves are not available for ammonia compressors. For this reason the advantage of time-delay undervoltage protection in refrigerating plants and on synchronous motors driving mechanical loads such as line shafts is limited to cases where the voltage variations are comparatively small and not of sufficient duration to throw the motor out of step.

Power Trash-Rack Rake Used by Wisconsin Utility

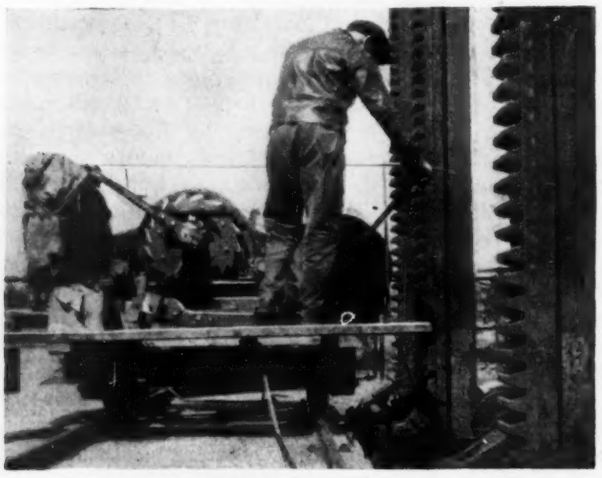


POWER TRASH RAKE IN OPERATION AT KILBOURN, WIS.

ANY obstruction to the free flow of water from forebay to tailrace is a direct subtraction from plant output in exactly the same way that coal stolen from the yard would cause a reduction in the over-all thermal economy of a steam station. Lost coal can be replaced, but when water is lost, that's the end of it. Water over the spillway does not turn any wheels; like Clementine, its power is lost and gone forever.

The Kilbourn plant of the Wisconsin Power & Light Company, which, with the other hydro plants of the system, carries the base load during periods of ample water supply, has paid for a power-driven trash rack rake in less than a year in increased generator output alone, not to speak of the saving in labor cost and reduction of time needed for clearing racks.

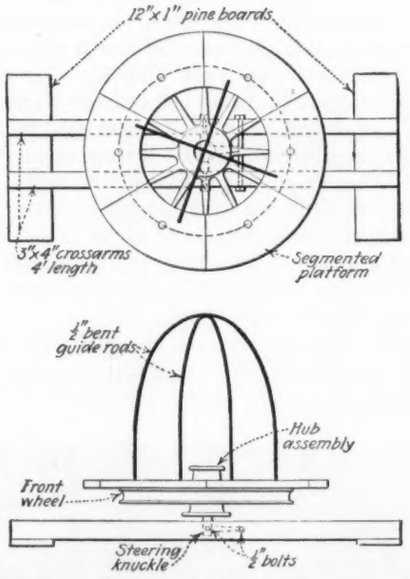
The illustrations show how the car carrying the winches and driving motor runs on a track along the top of the head-gate structure. The motor is 5 hp. and is arranged with gear reduction and a double clutch to drive either of the two winches. The cable from one winch hauls the rake up on the trash bars, and the cable from the second drum goes to the rake through a pulley located above the forebay and some distance away from the front of the rack. Both lines are attached to the rake by means of cable slings so that the rake will always have its prongs pointed to the trash bars. In operation the rake is raised to the surface of the water and carried away from the trash bars by the second cable. With enough tension on this line to keep it facing straight and with the pull-up cable loose, the rake is permitted to sink in the water, the current moving it up to the bottom of the trash bars. It is then pulled up, the car moved a distance equal to the length of the rake and the whole operation repeated.



WINCHES AND MOTOR FOR OPERATING TRASH RAKE MOUNTED ON CAR

Unreeling of Line Wire Facilitated by Special Rig

A LIGHT and inexpensive device for unreeling coiled conductors has been utilized by the Compañia Electrica de Cartago, Costa Rica, Central America. It is built largely of cast-off Ford parts—a front wheel, hub assembly and steering knuckle. The steering knuckle is located between two pieces of crossarms which are placed about 7 in. apart. Two half-inch bolts connect the two crossarms and the steering knuckle. This arrangement, with the addition of pine boards on either end of the crossarms, supplies a rigid base. The detachable rim is removed from the wheel and the latter is fastened to the spindle in the customary way. Six wooden segments are bolted to the wheel, using the old rim bolts and nuts, countersunk in the wood. Two pieces of ½-in. rod are bent into "U" shapes and fastened to the wooden platform by nuts and washers, to hold the roll of wire in a central position and prevent its crossing and kinking.



LINE WIRE REEL CONSTRUCTED OF FORD PARTS

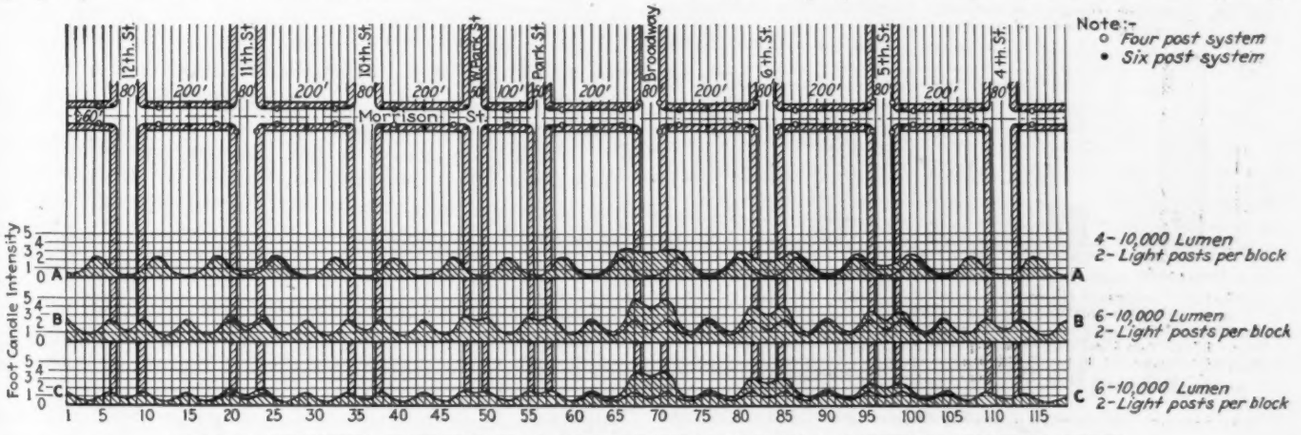
According to John Saxe, manager of the company, this is the lightest, easiest running reel he has used and is unusual in that it supplies a ball-bearing device at a most reasonable cost.

Importance of
Post Spacing in Street Lighting

Study of system proposed to reduce cost shows inadequacy of illumination at street intersections. Comparison made of three systems for lighting business street in Portland, Ore.

By FRANCIS H. MURPHY
Illuminating Engineer Portland Electric Power Company, Portland, Ore.

THE importance of location of lamp posts along a street with relation to the illumination at street intersections was clearly brought out in a recent study made in connection with a proposed street-lighting installation on Morrison Street, Portland, Ore. In order to keep down the cost of the installation it was seriously proposed to space the posts symmetrically along the street, as shown in the accompanying illustration, which would result in the posts being placed 30 ft. back of the property line from street intersections.



LIGHTING INTENSITIES RESULTING FROM THREE DIFFERENT METHODS OF LIGHTING A BUSINESS STREET

In the four-post system the location of posts is indicated by circles and in the six-post arrangement by round dots. The stations at which illumination values were determined were numbered in consecutive order down the center of the street. The upper curve, *A*, shows the illumination along this center line with the proposed four-post system, using two lights per post and 10,000-lumen lamps. The second curve, *B*, from the top shows the illumination along the same center line of the street with six posts per block, using a two-light post with 10,000-lumen lamps. The bottom curve, *C*, shows the illumination along the center line of the street for six posts per block, with two-light posts and 6,000-lumen lamps. These curves represent illumination upon the horizontal plane, and curves showing vertical illumination values are not shown. The point-by-point method was used in determining the illumination values. In all cases the distance from the light center to the sidewalk surface is 19 ft.

Under the proposed four-post plan, minimum lighting occurs at the middle of the street intersections, which are the very points where maximum illumination is required. The greatest danger of accidents is at street intersections, and accepted practice seems to bear out the statement that the average illumination at street intersections should be not less than twice that through the block. In the case of each of the other two curves for the six-post systems, it is readily seen from the curves that the average illumination at the street intersections is appreciably greater than that through the block—just how much will be shown later.

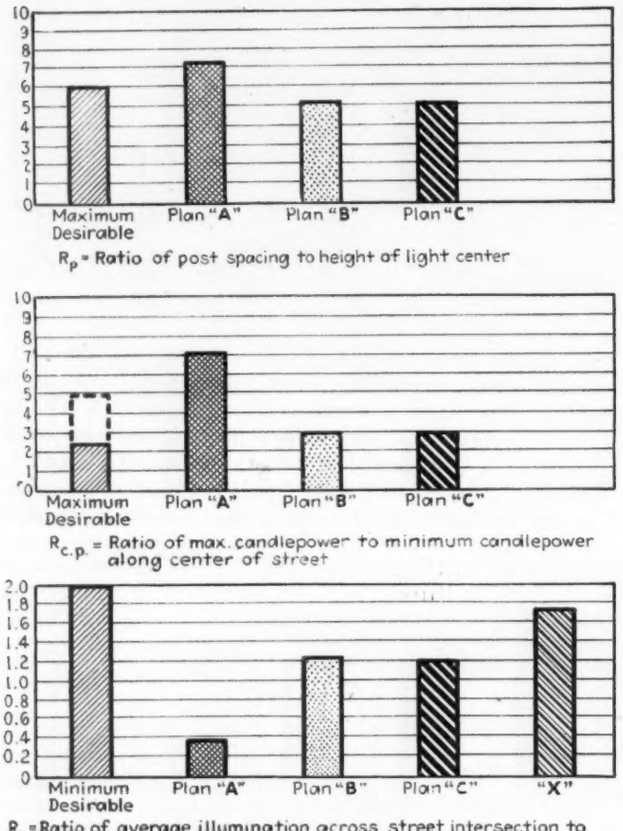
Illumination values were determined along the center line of the street for the proposed installation, as well as for installations which are similar to those already made on other streets in the business section of the city. The standard arrangement of posts heretofore has been six to a 200-ft. block, three on each side of the street opposite each other, two located at the center line of the block, one on either side of the street, and the four others located at the four property corners. The standard blocks in this district are 200 ft. from property line to property line, and the majority of the cross streets are 80 ft. wide from property line to property line. This, therefore, means with the six-post arrangement approximately 100 ft. between posts in the block and 80 ft. at the street intersections, whereas, with the proposed four-post system, the spacing between posts is uniform, being 140 ft., whether in the middle of the block or across street intersections.

With the four-post proposed arrangement, the symmetrical effect upon the street is improved so far as daylight appearance is concerned and the cost of installation is slightly less. However, from the illumination standpoint it is incorrect in every respect. This may be seen from a study of the curves herewith reproduced.

One argument set forth for the change in arrangement of street posts was that the cross streets would build up the illumination sufficiently to offset the deficiency of the proposed system. This not only places the

burden of lighting upon the cross streets but also assumes that all the cross streets will be lighted, which is far from the fact at the present time. That this assumption is a fallacy can also be shown from the data and curves submitted.

With the same type of lighting standards and glassware used in all cases and with the same sized lamps, the relative standing of the different systems with regard to glare conditions, whether the six-post or the four-post system is used, may be assumed to be equal and will not be further discussed.



COMPARISON OF PROPOSED STREET-LIGHTING SYSTEMS WITH A DESIRABLE STANDARD VALUE

Ordinates are expressed in ratios indicated below each chart

Three factors will be considered in making a comparison of the three systems. The first will be the ratio of post spacing to the height of the light center, which is represented by R_p; the second, the ratio of maximum candlepower on the street surface to minimum candlepower, represented by the symbol $R_{cp.}$; the third the ratio of the average illumination across the street intersections from property line to property line to the average illumination through the block, from property line to property line, represented by the symbol R_I. In this latter case the average illumination values used are the average values for the station points determined along the center line of the street. These values are not the true average illumination values for the sections referred to, but inasmuch as they are taken along the center line of the street for both the street crossing and the interblock sections, they bear the same relation to the true average illumination in each case, ignoring the effect of adjacent buildings upon the interblock section, and the proportion or ratio will hold true for the values used.

It is now considered by the best authorities that for heavy traffic streets a ratio of post spacing to light center height should not exceed 6.

For curve *A*, four-post 10,000-lumen system R_p equals 7.37.

For curve *B*, the six-post 10,000-lumen system R_p equals 5.26.

For curve *C*, the six-post system with 6,000-lumen lamps, R_p equals 5.26, the same as for curve *B*. This shows that the two latter arrangements are within what is considered good practice. The former indicates either that the spacing is too great or that the light center is too low.

Referring to the ratio between maximum and minimum candlepower values for curve *A*, $R_{cp.}$ equals 7.14, for curve *B* 3.06, and for curve *C* 3.1, showing a much more uniform distribution of lighting intensity over the street surface with the two latter proposals than with the four-post system.

The next ratio shows the comparison between the average illumination across the intersecting streets to the average illumination in the block, based, as stated above, on the average values determined along the center line of the street. These locations along the street are determind by projecting the property line of the intersecting streets across Morrison Street. The spacing referred to as "street intersections" is represented along the center line of Morrison Street from one projected property line to the next projected property line for the same street intersection. The section referred to as "through the block" is the remaining part of the center line of Morrison Street from projected property line to projected property line between adjacent street intersections.

As has been stated before, the average illumination across the street intersections should be at least twice the average through the block. In the case of curve *A* it is found that R_I equals 0.38; for curve *B* 1.25, and for curve *C* 1.23. In no case does the average illumination across the street intersection show twice the value of the average through the block.

However, as shown, even with the six-post arrangement, the illumination across the intersecting streets is not as high as it should be in proportion to the illumination throughout the block, where no street lighting is used on the cross streets. Nevertheless, assuming that the cross streets would be lighted with the same arrangement of posts, it is evident that the total illumination at street intersections would be materially increased, and in order to determine whether this would be greater than is desirable, a study was made for curve *B*, which is the six-post installation with 10,000-lumen lamps, where Morrison Street intersects Sixth Street, which has a similar installation of 10,000-lumen lamps. At this point the ratio R_I equals 1.79. As a check on this ratio, a study was made of curve *C*, which is for a proposed six-post system of 6,000-lumen lamps on Morrison Street where it intersects Fifth Street, which also is a six-post installation of 6,000-lumen lamps. In this case the ratio R_I was determined as in previous cases and was found to be 1.78.

It is very evident, therefore, from the investigation, so far as shown here, that the grouping of eight posts at an intersection with the six-post per block arrangement will not produce too high an illumination at street intersections in proportion to that through the block, and also shows very emphatically that the size of lamps in

the posts at the street intersections should not be decreased in value. This is another point about which an erroneous impression has arisen.

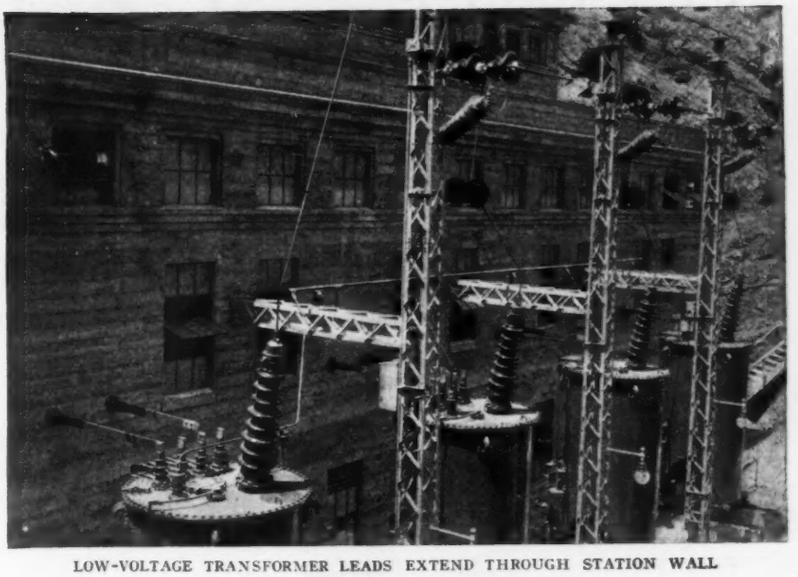
It might be noted with reference to the curves that at the Eleventh Street, Broadway, Sixth Street and Fifth Street intersections six-post lighting systems cross Morrison Street, and therefore the illumination is built up as shown by the overlying curves at these points, the higher curve showing the resulting illumination of the two systems.

Simplified Switching for Spare Transformer

By E. A. Crellin
Assistant Engineer Division of Hydro-Electric and Transmission Engineering, Pacific Gas & Electric Company

OF THE many schemes used for cutting in spare transformers, the Pacific Gas & Electric Company has found the method employed at its recently completed Melones power house to be as economical and satisfactory as any. As shown in the accompanying diagram, single-pole, double-throw disconnecting switches have been provided on both low-tension and high-tension sides of the transformers. The switches on the low side are operated with an ordinary switch hook, while on the high-tension side they are operated with crank and beveled-gear sash operators similar to those used on heavy windows. With this switching arrangement a damaged transformer can be cut out and the spare switched in almost instantly.

The use of bushing-type current transformers makes necessary some arrangement for switching the instrument transformers over to the spare transformer. On the switchboard a specially designed four-point switch has been provided which is used for transferring all relays and meters to the spare transformer should it become necessary to cut it in. Position A, B or C on the switch is used, depending upon in which phase the spare is substituted. Wiring connections for this switch and the instrument transformers are shown in one of the accompanying diagrams.



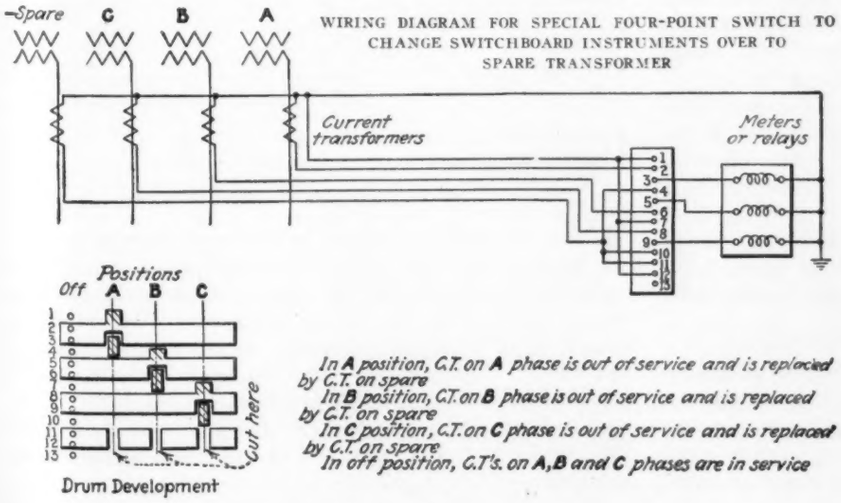
LOW-VOLTAGE TRANSFORMER LEADS EXTEND THROUGH STATION WALL IN PORCELAIN BUSHINGS
Bus consists of two ¼-in. x 4-in. copper bars

Another feature of the Melones installation which is brought out in the accompanying illustration is the extension of the 6,600-volt bus through the concrete wall of the station building, using standard porcelain wall bushings. This permits of a minimum of 6,600-volt bus outside the building and reduces the possibility of short circuit due to the small spacings commonly used on bus work of this voltage.

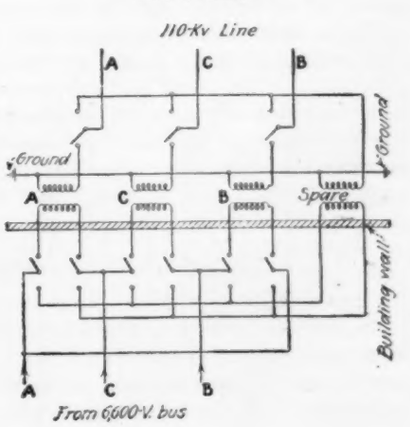
High Voltage in Germany

AN ELECTRIC installation which, it is said, is not equaled in size in Germany has just been put into operation. The newly erected transformer station at Rheinau near Mannheim in Baden connects large central power stations at Murgwerk, Mannheim (Rhine-Westphalian Electric Corporation) and the Pfalzwerk. The transmission is effected partly by 100,000-volt and partly by 220,000-volt lines. The open-air station by which the connection with the Rhine-Westphalian Electric Corporation is effected is at present being fed by 110,000-volt and later will receive 220,000-volt service. No reference is made to the higher transmission voltages in Germany which have been rumored of late.

WIRING DIAGRAM FOR SPECIAL FOUR-POINT SWITCH TO CHANGE SWITCHBOARD INSTRUMENTS OVER TO SPARE TRANSFORMER


Spare
C
B
A
Current transformers
Meters or relays
Positions
Off
A
B
C
Cut here
Drum Development
In A position, C.T. on A phase is out of service and is replaced by C.T. on spare
In B position, C.T. on B phase is out of service and is replaced by C.T. on spare
In C position, C.T. on C phase is out of service and is replaced by C.T. on spare
In off position, C.T's. on A, B and C phases are in service

SWITCHING ARRANGEMENT WHICH PERMITS ALMOST INSTANT THROWOVER TO SPARE TRANSFORMER

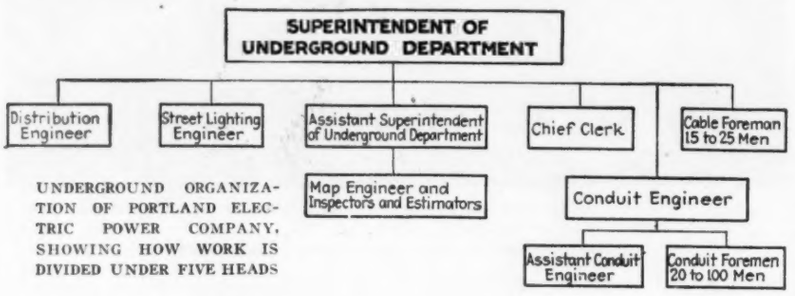


Selection and Training of Underground Force

By J. M. Gillham

Superintendent Underground Department, Portland Electric Power Company, Portland, Ore.

NECESSITY for careful selection and training of men for underground construction work and thorough organization of the work cannot be too strongly emphasized, in the opinion of the writer. Specialization in underground work is absolutely necessary for maximum efficiency. In order to develop a man to the limit of his ability he should be assigned to a particular branch of the work, receive all the information pertaining to that particular job and then be held responsible for results. If he is made of the right material, he will soon develop initiative and take all the responsibility that may be placed upon him. After a man has been carefully selected for a given position he should be made to demonstrate his ability before he is allowed to shift to another position or to a different department.



UNDERGROUND ORGANIZATION OF PORTLAND ELECTRIC POWER COMPANY, SHOWING HOW WORK IS DIVIDED UNDER FIVE HEADS

College men should make fine men for cable and conduit engineering, but it is a notable fact that there are few college-trained men in underground work today. The reason is that little underground engineering is taught in our universities. Most of the information in published form comes from manufacturers' bulletins and technical magazines. Too frequently college men who take up public utility work have the idea that they can spend just enough time in each department to get a bird's-eye view of the whole public utility machine and then step into an executive position. This is fine for the individual, but quite unsatisfactory from the point of view of the department manager, who believes that a man should master one job before he is allowed to shift to another. The practical man who supplements his knowledge with theory by studying nights also makes a very good, reliable man for underground work.

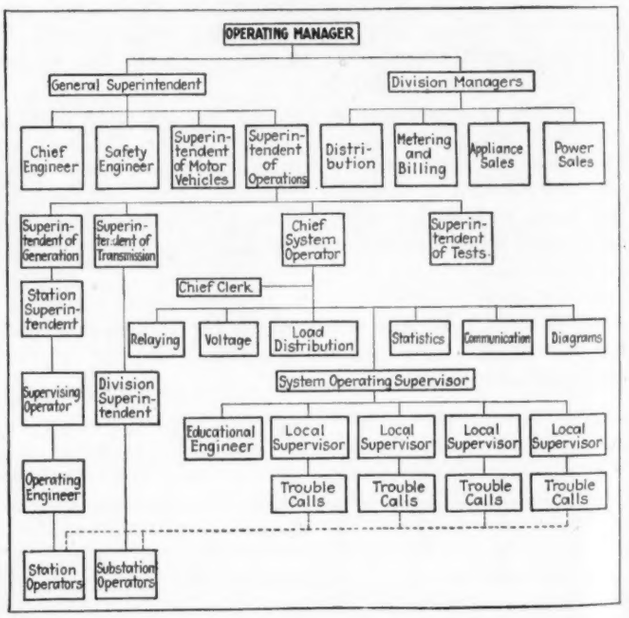
Employment departments in some of the larger utilities are doing much to assist department heads in the selection of men, and such departments have much to commend them if they are directed by competent men. Some utilities go further than merely interviewing prospective employees by maintaining schools for training new employees for technical and clerical positions a short time before assigning them to regular employment.

Underground Organization

Organization of underground work varies somewhat with different utilities, depending upon the amount of work and special local conditions. With the smaller companies, engineering and construction generally come under one head, but with larger companies these of necessity are functions of separate departments. Wherever possible, the writer favors organization under one head, such as the type of organization used by the Portland Electric Power Company shown in the accompanying chart.

Regardless of the type of organization, it is important that there shall be no division of responsibility. When assigning work where two or more men are necessary, one man should be made responsible if efficiency is expected and "buck passing" eliminated. In the organization shown in the diagram the factor of dodging responsibility is eliminated by dividing the work under five heads—distribution engineer, street-lighting engineer, assistant superintendent, conduit engineer and conduit foreman—each of whom has an assistant. These men are given full information pertaining to their work and their duties are clearly defined; consequently there is no division of responsibility. A point that the writer considers important is that each man be given to understand that when advice or information is sought from another and is used to form an opinion or make an estimate or recommendation, that man cannot shift responsibility to the person consulted if the information later proves to be wrong. Experience has shown that this principle works out very well in practice and removes a lot of guesswork on the part of employees.

Operating Organizations—I

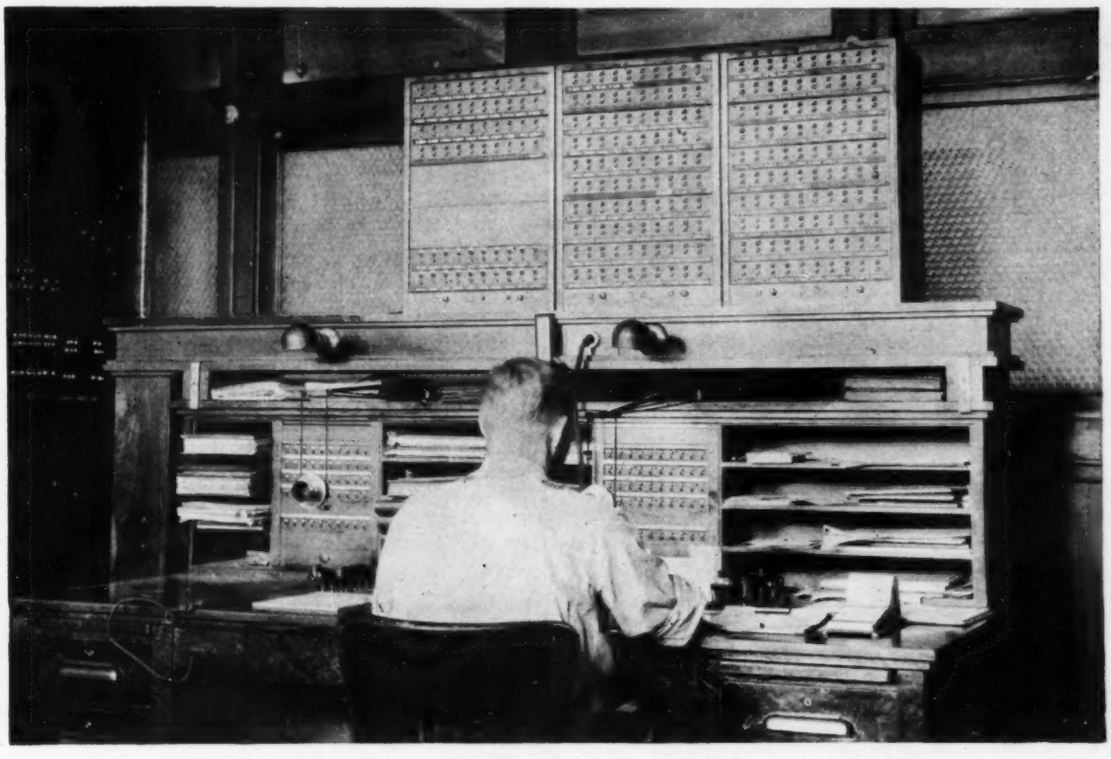


THE organization of the operating department of an electric light and power company serving a populous industrial territory and covering a considerable area is shown in the illustration. This company serves more than 150,000 electrical customers in more than 400 communities. High-voltage transmission lines exceed 750 miles in length and distribution lines exceed 3,000. The installed capacity is nearly 225,000 kw. More than 858,000,000 kw.-hr. was delivered to customers in the calendar year.

Experience with Supervisory System

Necessity for complete isolation from control circuits. Troubles encountered in operation, their causes and corrections. Supervision over fully automatic system approaches service ideal

By F. O. JENKINS
Engineer Kansas City Power & Light Company, Kansas City, Mo.



SUPERVISORY INDICATING LAMPS ARE IN CABINETS OVER DESK OF LOAD DISPATCHER

WHEN work now in progress in two of the stations of the Kansas City Power & Light Company is completed, all of the substations in the alternating-current system will be fully automatic, their operation being entirely determined by, and responding to, load conditions on the system. The supervisory system by which the load dispatcher is kept continuously informed of conditions in the substations is strictly within the meaning of its name; it contains no elements of direct system control. The supervisory installation is of the distributor type, a contactor arm rotating at constant speed over the face of circularly arranged contact blocks in each substation and moving in synchronism with like devices in the office of the load dispatcher. Installations of this kind are now in use commonly enough to permit omission of a description of the system from this article.

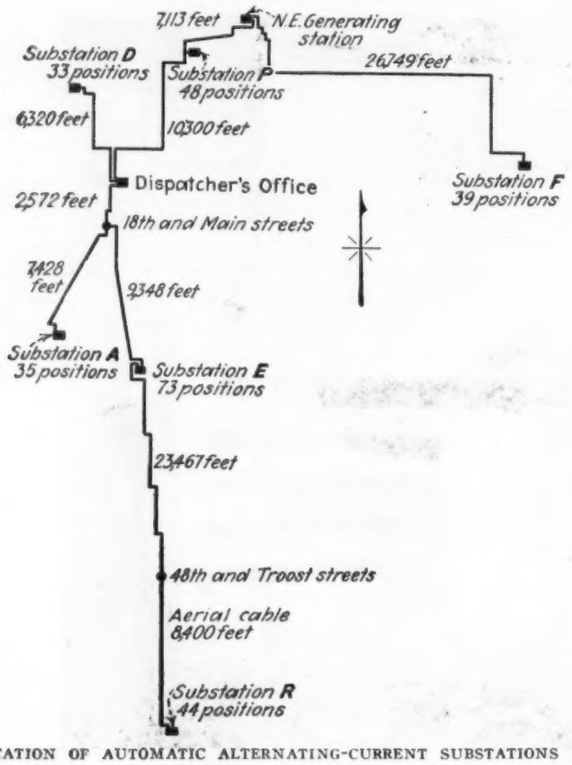
The location of the automatic alternating-current substations are shown in the diagram. This indicating system was first installed in Substation R. It went into service on Aug. 26, 1924. The indicating system at Substation A went into service on Sept. 2, 1924. The indicating cable between substations is underground except from 48th Street and Troost Avenue to Substation R, where it is aërial. The cable to Substation F is routed via the Northeast generating station so that the existing duct lines could be used. A sixteen-pair cable from the main office to the Northeast plant was installed, in order to have conductors available for additional equipment between these stations.

The cabinets shown above the dispatcher's desk in the main office building contain the supervisory indicating lamps. The relay and distributor cabinets are located in the basement of the same building. Type U-31 telephone cable is used between the lamp and relay cabinets, a distance of approximately 140 ft. The same type cable is used between relay and distributor cabinets. This cable contains all wires between these cabinets except the battery leads. Only one set of 24-volt battery leads was installed between the lamp and relay cabinets for all stations. The same type cable is also installed between the distributor and the terminal cabinet in the substation.

No. 14 wire is used between this terminal cabinet and the auxiliary switches on the oil circuit breakers or other equipment connected to the indicating system.

The leads for the 24-volt battery between the relay and lamp cabinet are of No. 10 wire. As the first installation was for two stations, a resistance had to be placed in this circuit to prevent excessive voltage on the indicating lamps. By experimenting it was found that the lamps could be operated at about 21 volts at their terminals and give clear indication. This voltage increased the life of the lamps so that only five lamps out of 370 have been replaced in the last six months.

A 120-volt battery is used for operating the indicating system. The relays themselves operate on 60 volts and 8 milliamperes. The energy for these relays is received



LOCATION OF AUTOMATIC ALTERNATING-CURRENT SUBSTATIONS IN KANSAS CITY, MO.

All cable is underground except that noted and contains six pairs of No. 19 A.W.G. paper-insulated conductors except from dispatcher's office to Northeast power house. On this run sixteen-pair cable is used; to Eighteenth and Main eleven-pair cable is used.

from only one-half of the battery. The half of the battry used depends on whether the breakers are opened or closed. The normal position for the great majority of the breakers on the system is closed; therefore the drain on the batteries is small but unequal for the two halves. For this reason the battery was divided into two equal sections, and a four-pole, double-throw knife switch was installed to permit the transfer of the load from one section to the other, thereby keeping the battery balanced. The present practice is to transfer the load on the battery sections when the pilot cells indicate a difference of five points in gravity between the two halves. This reversal is made approximately every two weeks.

Protection of Cable Between Stations

The cable between stations is a standard No. 19 A.W.G. paper-insulated telephone cable. This was installed in the same duct with the transmission and distribution cables. In the event of a power-cable breakdown an injury to the indicating system cable might result if protection were not provided for the indicating equipment. The manufacturer proposed that the standard telephone protection be used. Although this equipment gives satisfactory protection under most conditions, it was feared that in this case the small gap between the carbon blocks used would permit dust to settle so that during a storm the moisture in the atmosphere would ground the system, thus making it inoperative. The manufacturer then suggested that the carbon blocks be replaced with a small vacuum arrester; this is the standard practice. Up to the present time there have been no cases of trouble on the power cables that have damaged the indicating cable other than as described in the following paragraph. Neither have there been any cases of trouble due to failure of the arresters. These arresters are tested once each year, which is the only maintenance required. The only case of trouble in connection with the cable in the past seventeen months was a ground on one of the cable terminal blocks.

Metal rings were used to fasten the aërial cable to the messenger. Both cable and messenger were grounded at intervals. This pole-line carried the 13,500-volt feeders for Substation R, and 2,540/4,400-volt distribution circuits. Current induced in the indicating cable sheath by surges, lightning or flashes from adjacent power circuits left the cable sheath at some of the metal rings, causing burns; these burns permitted water to enter the cable and resulted in short-circuiting the conductors. This was remedied by removing the ground connection from the messenger and inserting strain insulators in the messenger between the point where the cable left it and the pole to which the guys were fastened; ground connections were also installed on the cable sheath, and no further cable trouble has been experienced.

Failure to Indicate Operation Corrected

When the system was first placed in operation, some trouble was experienced by the studs through the fiber disk of the distributor becoming unsoldered from the collector rings, thus causing an open circuit. When this occurred on the distributor at the dispatcher's station, the operator's lamp did not show an open circuit and this condition was not discovered until the next normal switch operation, when no indication was received that it had taken place. When the trouble was at the substation, the open circuit indication was received. This trouble has been corrected by the manufacturing company in its later type of distributor.

Each automatic substation has its own separate control battery and charging motor-generator set. Two propositions were considered for battery supply for the indicating system: first, the installation of an additional battery and charging motor-generator set for the indicating system alone; second, the utilization of the control battery and motor-generator set already in service. As the indicating system battery required a neutral tap, it was decided to install a battery for this system in each station in preference to bringing out a tap on the control battery. In order to save the expense of an additional motor-generator set the one already in use for charging the control battery was connected to charge the indicating system battery also. In normal operation the batteries float across the line; therefore they require only a "trickle" charge. The motor-generator set that was installed in the station had a capacity sufficient to charge the control battery fully in eight hours. As the indicating system battery was small, the motor-generator set

was of sufficient capacity to carry both the control and indicating systems. At the dispatcher's station one 120-volt battery was sufficient for all indicating equipment except the 24-volt lamps. This 120-volt battery was charged from the Edison system, which has a grounded neutral.

Locates Mysterious Source of Trouble

The arrangement outlined, which tied together both control and indicating systems of all substations, appeared satisfactory on paper and was considered adequate by the factory and local engineers. However, from the time the system was first placed in operation false indications were registered at various intervals. No explanation could be found, although every test was made to locate the trouble. This condition continued until in the course of a routine test a 125-volt ground on the system was discovered. A 110-volt lamp was placed between the system and the ground. It burned with full brilliancy for a few seconds then went out. The system no longer tested grounded.

This seemed to be a clue to the source of all the trouble. It appeared that a low-capacity ground would build up either on the control or on the indicating system and would then discharge through some of the indicating relays and cause them to operate, giving a false indication. The relays on the indicating system require a current of only 8 milliamperes to operate them; therefore they would respond to very low current flow. If this discharge occurred in the control system, no result was noticed, as it was evidently not of sufficient capacity to operate the control relays.

To remedy this condition a motor-generator set was installed at each station and at the dispatcher's office to charge the indicating system batteries. Since completing this installation the indicating system has been entirely separate from any other control system and no recurrence of this trouble has been experienced.

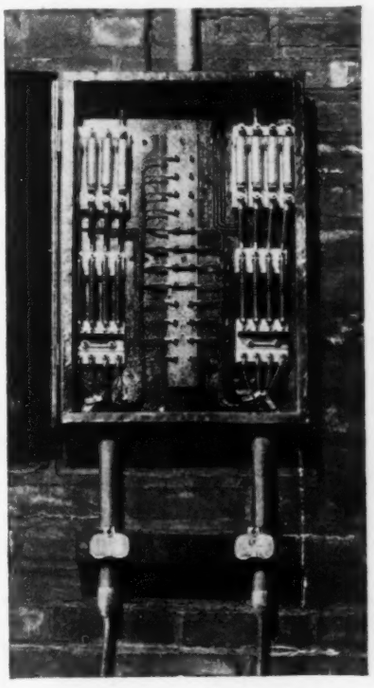
Analysis of Troubles and Remedies

There have been only 36 cases of trouble of any kind on the indicating system since making this change. These are shown in the table on page 616. During the period that was covered by this tabulation the system furnished indications from four stations having a total of 185 breaker positions.

The distributor motor, which is a 1/50-hp. direct-current inclosed unit with a speed-regulating device, has small clearances and the dust from the brushes has caused numerous grounds. Most of these were found in the course of periodic inspections and usually before they could cause a false indication. However, in some cases a false indication was received before the ground was discovered. It has been difficult to obtain a brush that would not give off excessive dust and at the same time not be too hard on the commutator. Experiments are being made with brushes of different manufacturers and some of the new type brushes seem to be overcoming this trouble. All exposed current-carrying parts were painted with insulating varnish. In places it was difficult to secure a good coating of this varnish. In addition, the temperature in the inclosed motor was high and it was found that the varnish had a tendency to crack.

The revolving brushes on the distributor are listed in the table as a major source of trouble. These brushes are of a rather light metal and the factory recommended that they be inspected every 30 days with the expectation that they would probably have to be changed or replaced every 60 days. Experience has shown that these brushes last considerably longer than this. However, one shipment of these brushes was not of good quality and caused practically all the trouble.

The greatest number of false indications was caused by the release magnet sticking and throwing the distributors out of synchronism. In the later type of equipment, which is being installed in Substations F and P, this difficulty has been remedied by making a small wiring change in the release magnet circuit, thereby allowing the magnets a greater operating margin. This improvement is also being made in the former installations. It is believed that these changes will practically eliminate the trouble with the release magnet and also reduce the failures from causes listed as the first two items under "relays." The reason for this is that each relay is energized normally not longer than one-tenth of a second. Therefore a slight delay caused by a sluggish release magnet would decrease the time the relay is energized and cause incorrect operation.



VACUUM ARRESTER EQUIPMENT AT CABLE TERMINALS

Another source of trouble that has been removed was that the resistance lamps worked loose in their sockets. This was remedied by replacing the old sockets with special lock sockets recommended by the manufacturer.

The system is inspected and cleaned every week and any part found worn is replaced. This inspection consists of a test for grounds, checking the speed of the distributing motor, examination of the metal brushes on the distributor, cleaning the distributor contacts and oiling all necessary parts. This does not require more than one hour's time for each distributor. Inspections are made at regular trips of the maintenance men through the substations. Once every six months the motor is removed and the bearings and speed regulating device are inspected. This requires about two hours' time for each distributor. The relays are checked every six months. When trouble develops, an additional inspection is made of the distributors or relays in which the fault occurred. A report of this equipment is made by the maintenance men. This is made on a form that includes all the automatic equipment in the station. The operation of the supervisory system does not require any increase in maintenance personnel.

Limiting False Indications

One source of trouble not listed in the accompanying tabulation is due to the fact that the distributor makes one revolution every five seconds, so that it checks the position of each breaker in the station once during this

Troubles Reported by Months, Showing Causes

	1926												1927					
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	Total
1. Distributor Motor: Ground on distributor motor	.....	.....	.....	F	.....	.....	.....	.....	.....	.....	2–F	.....	.....	.....	F	.....	.....	4–F
Ground on speed-regulating device	.....	.....	M	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1–M
2. Distributor: Worn coupling on distributor	F	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1–F
Worn brush on distributor	.....	2–F	.....	.....	.....	F	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3–F
Brush on distributor out of adjustment	.....	.....	.....	.....	.....	.....	F	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1–F
Brush on distributor broken off	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	F	.....	F	.....	.....	.....	.....	2–F
Release magnets sticking	.....	.....	.....	.....	.....	2–F	.....	.....	.....	F	.....	.....	F	F	F	.....	.....	6–F
3. Relays: Relay in neutral position causing both lights to burn	.....	.....	.....	F	.....	.....	.....	.....	.....	F	.....	F	.....	.....	.....	.....	.....	3–F
Alarm relay could not reset due to polarized relay not making contact	.....	.....	.....	.....	M	.....	.....	.....	M	.....	.....	2–M	2–M	.....	.....	.....	.....	6–M
Relay out of adjustment	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	F	1–F
4. Miscellaneous: Ground in cable between stations	F	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1–F
Switch in alarm circuit left open	M	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1–M
Resistance lamps worked loose due to vibration	.....	F	.....	F	.....	.....	.....	.....	.....	.....	F	.....	.....	.....	.....	.....	.....	3–F
Auxiliary switch failed to make contact due to oil circuit breaker being out of adjustment	.....	.....	.....	F	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1–F
Loose connections in terminal cabinet	.....	.....	.....	.....	.....	F	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1–F
Ground on system*	.....	.....	.....	.....	.....	.....	.....	.....	F	.....	.....	.....	.....	.....	.....	.....	.....	1–F
Total	2–F	3–F	.....	4–F	.....	4–F	1–F	.....	1–F	2–F	4–F	1–F	2–F	1–F	2–F	0	1–F	28–F
	1–M	.....	1–M	.....	1–M	.....	.....	0	1–M	.....	.....	2–M	2–M	.....	.....	.....	.....	8–M
																		36

F. Failure. Shows switch operated when no switching occurred. M. Minor trouble in which no switching was involved.
* This ground consisted of several low-voltage grounds at several places on system which were sufficient to give a false indication of switch operation.

interval. If a breaker should open and again close within this period of five seconds, it would be back in its original position when the distributor makes its next check. Therefore the dispatcher would receive no indication that the operation had taken place. This is to be expected with any indicating system having a time interval between successive checks on a position of a breaker. In one particular case of trouble the Veeder counter on the breaker indicated that it had operated several hundred times, although no indication of this was received at the dispatcher's office. All breakers are now equipped in such a manner that after pumping a few times they will be locked out. This position is then indicated to the dispatcher.

In one case, even though a breaker opened under normal operation, the auxiliary switch failed to function on account of faulty adjustment of the breaker itself. Inasmuch as the breaker had opened normally, this was counted as a failure of the indicating system, although it actually resulted in locating the trouble in the breaker, preventing an interruption to service later on.

As the character of the load varies slightly from day to day, the time elapsing from the underload to overload condition or vice versa is about the same each day. The dispatcher soon knows when to expect the change. There have been several cases in which the indicating system showed that the station had not completed this cycle of operation. Upon inspection some equipment was found that had not functioned properly. In case the sequence of operation should have been from overload to underload no material damage was done except there was less efficient operation of the station. When the station was in the underload position and failed to go to the overload position, serious overloading of the feeder cables or transformers might have resulted—at least an interruption to service might have resulted due to the thermal relay tripping off the station.

One of the particularly interesting cases occurred a short time ago when an exceptionally heavy rain flooded one section of the city. One of the 2,540/4,400-volt circuits fell into the flood water at some distance from the substation and the fault current was not of sufficient value to operate the overcurrent relays and trip the automatic reclosing circuit breaker. However, this abnormal current caused the station to go to the overload position. This condition occurred at a time when the station usually remained in the underload position, hence the dispatcher knew something was wrong somewhere and sent a maintenance man to the substation to investigate the cause of this unexpected switching. When he arrived, everything was found as indicated and in operating condition. He read the ammeters on all the circuits and found that one of them read off the scale. This circuit was patrolled, the trouble was soon found and cut into the clear and the voltage regulators on this circuit were saved from damage.

Conclusions on Value of System

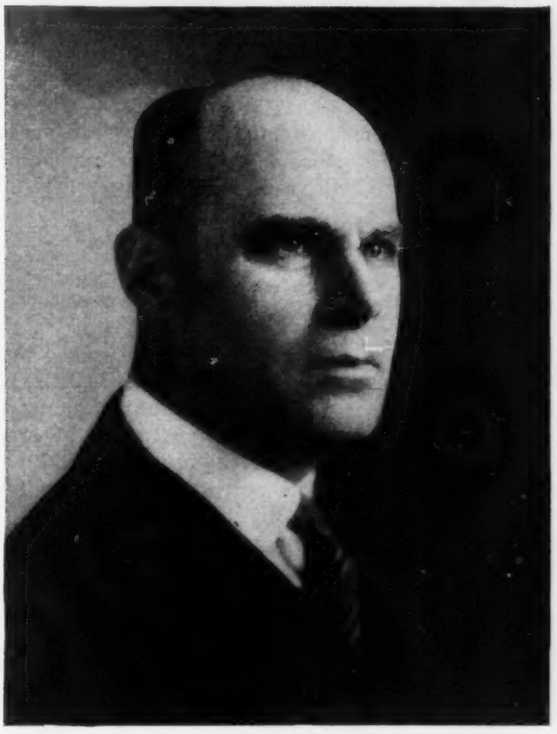
That this system had proved itself of recognized value was shown by the fact that it was included without question when the proposition of changing Substations F and P from manual to automatic operation was considered. The cost of this indicating system is only 6.6 per cent of the total cost of the substations which the system serves. The experience of this company in operating these stations has demonstrated that the decision to install the automatic substation equipped with visual indication was fundamentally correct.

Introducing the Utility Operator to the Banker

Few operating men realize the amount of care and detailed study the banker must put into the raising of new capital

By C. W. KELLOGG
President Engineers Public Service Company

SOMETIMES the utility operator is inclined to think of banking problems as confined in a watertight compartment entirely separate from his own. That no barrier, but rather a decidedly close relationship exists between the two departments is shown by Mr. Kellogg, whose earlier extensive training in preparing issues to submit to the bankers enables him to speak on the subject with authority.



C. W. KELLOGG

TO THE average operating man the investment banker is a rather shadowy, indefinite personage. The operator prepares his estimates of how much money will be needed for this or that extension to plant to care for the constantly growing demand for electricity. From his viewpoint that ends the matter; it is then up to the company to furnish the money to do the work. It is true that in recent years, through campaigns for "customer ownership," the operating men—largely in the sales force, to be sure—have learned what it means in organization and effort to raise new capital; yet when an issue of the utility company's bonds is taken by an investment banking house (and most of the new capital comes through this channel), it often seems to the man in the field a pretty easy thing for the banker.

Few operating men realize the amount of care and detailed study the investment banker puts into the problem of raising new capital for the utility. Many of the most important tests of the soundness of a utility's securities, which in a given community are well known to the public, have to be shown to the investment banker, who is often far away. The banker must know from a satisfactory demonstration that the new capital he is raising is needed either to take care of growth of load or to produce economies which will show a saving after paying all charges on such new money. He must satisfy himself that the management of the property is wise, sound, experienced and progressive, so that he may feel sure that his investment will be maintained in first-class condition out of income, that the business will be actively developed and that proper allowance will be made for retirements and renewals. He must know whether the general situation of the community served is such that it can be expected to continue to grow and thus utilize the additional facilities his money is buying. He must assure himself, particularly in the case of bonds, that the company's right to do business in the community will remain unimpaired until the obligation is due. He must inform himself as to how the company gets along with its customers and the public authorities and whether its rates are fair and reasonable. The satisfactory outcome of all these general inquiries, each of which involves many details too numerous to mention, rests on the company's past record of achievement, in which each operating man has had his essential part.

The study and analysis of this detailed information has developed into an exact science with the investment banker. The reasons for this careful detail study are twofold.

WHY DETAILED STUDY IS ESSENTIAL

In the first place, the investment banker stands in a position of responsibility between the utility and the investor. The banker's reputation for sound and accurate judgment and analysis is at stake in every issue he brings out. His clients must be able to rely upon the soundness of the securities he sells or his business will languish and fall away. Just as the average customer of a utility buys its preferred stock largely from a feeling

of confidence in his community and the people operating his utility, so the customer of the investment banker buys his offerings largely on the basis of confidence in the care and intelligence used by the banker in the study and analysis of the securities he buys to offer to his clients. Investment banking rests, not on "hunches," but on careful and thorough study of a great mass of detailed information.

The second reason for this meticulous care in gathering detailed information is an outgrowth of the first and arises from the demands of the larger investors, particularly the savings banks and life insurance companies. These have been educated by the bankers themselves to the most searching analysis of each security they buy, so that nowadays it is quite impossible to sell to the large investor without furnishing him the most complete array of facts and figures on each security issue presented to him.

Capital Raised Through Customer Sales

The total investment in electric light and power business in the United States at the present time is about $8,900,000,000. Of this the total amount raised by the sale of securities to customers is about $1,400,000,000, or something less than 16 per cent. While the amount thus raised through customer ownership is not large in percentage, it is most impressive in total volume and a very important part of the equity portion of the capital structure of the industry supporting its senior securities. The remaining 84 per cent of the total capital invested in the industry was raised to a considerable extent through the sale of additional stock from time to time to existing stockholders and to some extent represents the investment of surplus net earnings, but the largest part of it was raised through purchases for public offering by investment bankers. This indicates the importance to the utilities of the services of the investment banker and the large extent to which the savings of the people are invested in the electric light and power business. It should give an added thrill of interest to the operating man's life work to realize the amounts of other people's money which are intrusted to his charge and to visualize the great organizations of experts who are examining the results of his work and constantly seeking new sources of capital to further his activities.

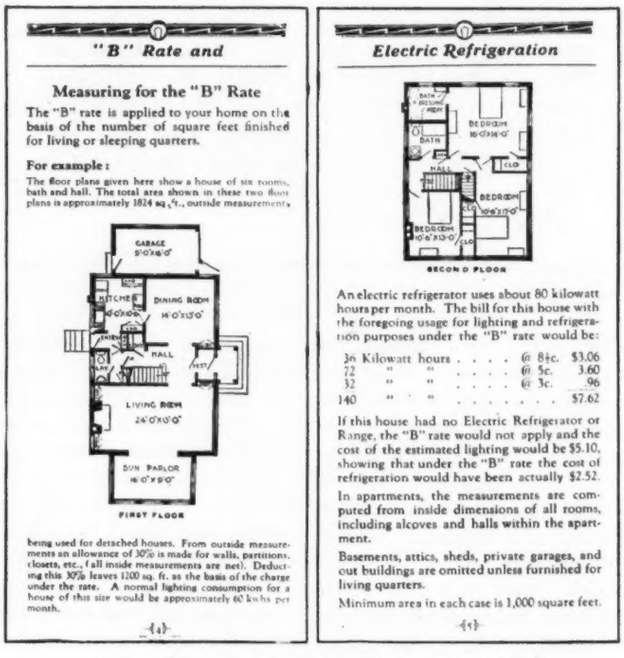
Industry Guided by Facts

Among the most striking developments in this country's business in recent years have been the conservation of labor by the greater use of mechanical power, more intensive and better organized sales effort and the much wider diffusion of statistical data on all phases of business. It is most impressive to consider the wealth of detailed information upon which investors may rely now compared with the relatively incomplete information of twenty years ago when rumors and "hunches" played so much larger a part. It is inspiring to those engaged in the electrical business to feel that electricity is inherent in the first mentioned of these developments and that the electrical industry has been prominent in the two other developments.

It is desirable that every operating man, no matter what his department or how humble his position, should have a clear picture of the capital cycle, beginning with the sale of his company's securities to the ultimate investor and ending with the delivery of first-class service to the local customer, just as it is desirable for the power-station man to know the heat cycle and for the accountant to know the physical things his figures refer to. One of the many valuable functions the utility holding companies have performed has been possible because their own view of the utility field is broader than that vouchsafed to an isolated property, thus enabling them to bring to the men in their operating organizations a feeling of the relation of each to the other parts of that organization and to the customers served. My object is to call to the attention of the operating man an even wider view of his company's activities.

Making Promotional Rates Clear to the Public

COMBINATION rates need to be made as clear as possible to utility customers in order that misunderstandings may be prevented and service usage increased. Recognizing this point, the Edison Electric Illuminating Company of Boston recently issued an eight-page, $3\frac{1}{2}$x$6\frac{1}{4}$-in. printed folder describing the application of its


"B" Rate and
Measuring for the "B" Rate
The "B" rate is applied to your home on the basis of the number of square feet finished for living or sleeping quarters.
For example:
The floor plans given here show a house of six rooms, bath and hall. The total area shown in these two floor plans is approximately 1824 sq. ft., outside measurements
GARAGE
DINING ROOM
HALL
LIVING ROOM
SUN PARLOR
FIRST FLOOR
being used for detached houses. From outside measurements an allowance of 30% is made for walls, partitions, closets, etc., (all inside measurements are net). Deducting this 30% leaves 1200 sq. ft. as the basis of the charge under the rate. A normal lighting consumption for a house of this size would be approximately 60 kwhs per month.
Electric Refrigeration
BEDROOM
BATH
HALL
BEDROOM
BEDROOM
CLO
SECOND FLOOR
An electric refrigerator uses about 80 kilowatt hours per month. The bill for this house with the foregoing usage for lighting and refrigeration purposes under the "B" rate would be:
36 Kilowatt hours . . . . @ 8½c. $3.06
72 " " . . . . @ 5c. 3.60
32 " " . . . . @ 3c. .96
140 " " $7.62
If this house had no Electric Refrigerator or Range, the "B" rate would not apply and the cost of the estimated lighting would be $5.10, showing that under the "B" rate the cost of refrigeration would have been actually $2.52.
In apartments, the measurements are computed from inside dimensions of all rooms, including alcoves and halls within the apartment.
Basements, attics, sheds, private garages, and out buildings are omitted unless furnished for living quarters.
Minimum area in each case is 1,000 square feet.

APPLICATION OF PROMOTIONAL RATE EXPLAINED

lately established "B" rate in terms which it is believed offer little difficulty of comprehension by the non-technical user of its service. The rate is of the promotional type, with a combination of charges based on floor area and energy consumption, and applies to customers using an electric range or refrigerator, but one meter being installed.

Under this rate the price of service is 8.5 cents per kilowatt-hour for the first 3 kw.-hr. per month per 100 sq.ft. of floor area; 5 cents per kilowatt-hour for the next 6 kw.-hr. per month per 100 sq.ft. of floor area and 3 cents per kilowatt-hour for the excess. The folder illustrated shows the method of measuring homes for this rate. It gives an example of how the rate enables a residential customer to enjoy heavy-duty service in the home at a cost decreasing per unit as the energy consumption is increased.

Low Rates Attract Domestic Power Load

AN ATTRACTIVE rate structure enables the city of Burley, Idaho, to serve a relatively large number of its customers with electric water heating and cooking. Burley has no power plant, but buys power at wholesale from the United States Reclamation Service, Minidoka Project. The greater part of the output of the Minidoka plant is used for pumping water for irrigation purposes. After the close of the irrigation season the power is sold at wholesale at a rate cheap enough to permit its use for heating houses in the various towns on the project.

Number of residence service connections	897
Number of commercial service connections	245
Number of heating consumers	295
Total kilowatts connected heating load	2,254.9
Number of water-heating consumers	136
Total kilowatts connected water-heating load	274.2
Number of cooking consumers	164
Total kilowatts connected cooking load	893.4

Power is purchased from the United States Reclamation Service on a demand basis, with a sliding scale. A charge of $2 per kilowatt demand for which the city has 50 hours' use constitutes the base charge. The next 50 hours' use of the demand is billed at $0.03 per kilowatt-hour. The next 50 hours' use is at $0.02 per kilowatt-hour. The next 150 hours' use is billed at $0.01 per kilowatt-hour, and all remaining kilowatt-hours at $0.005. The flat-rate air heating has a rate of $1.25 a month for each kilowatt of connected load, wholesale.

Light and Appliance Rates.—No charge less than $1 for this class of service.

Rate is $0.07	per kw.-hr. for the first	25 kw.-hr.
0.065	per kw.-hr. for the next	25 kw.-hr.
0.06	per kw.-hr. for the next	50 kw.-hr.
0.055	per kw.-hr. for the remainder	

Cooking Rates.—Minimum charge $0.50 per kilowatt connected load. No charge less than $1.

Charge $0.03	per kw.-hr. for the first	200 kw.-hr.
0.025	per kw.-hr. for the next	100 kw.-hr.
0.02	per kw.-hr. for the next	100 kw.-hr.
0.015	per kw.-hr. for the next	600 kw.-hr.
0.01	per kw.-hr. for the next	1,000 kw.-hr.
0.008	per kw.-hr. for the next	3,000 kw.-hr.
0.007	per kw.-hr. for the remainder	

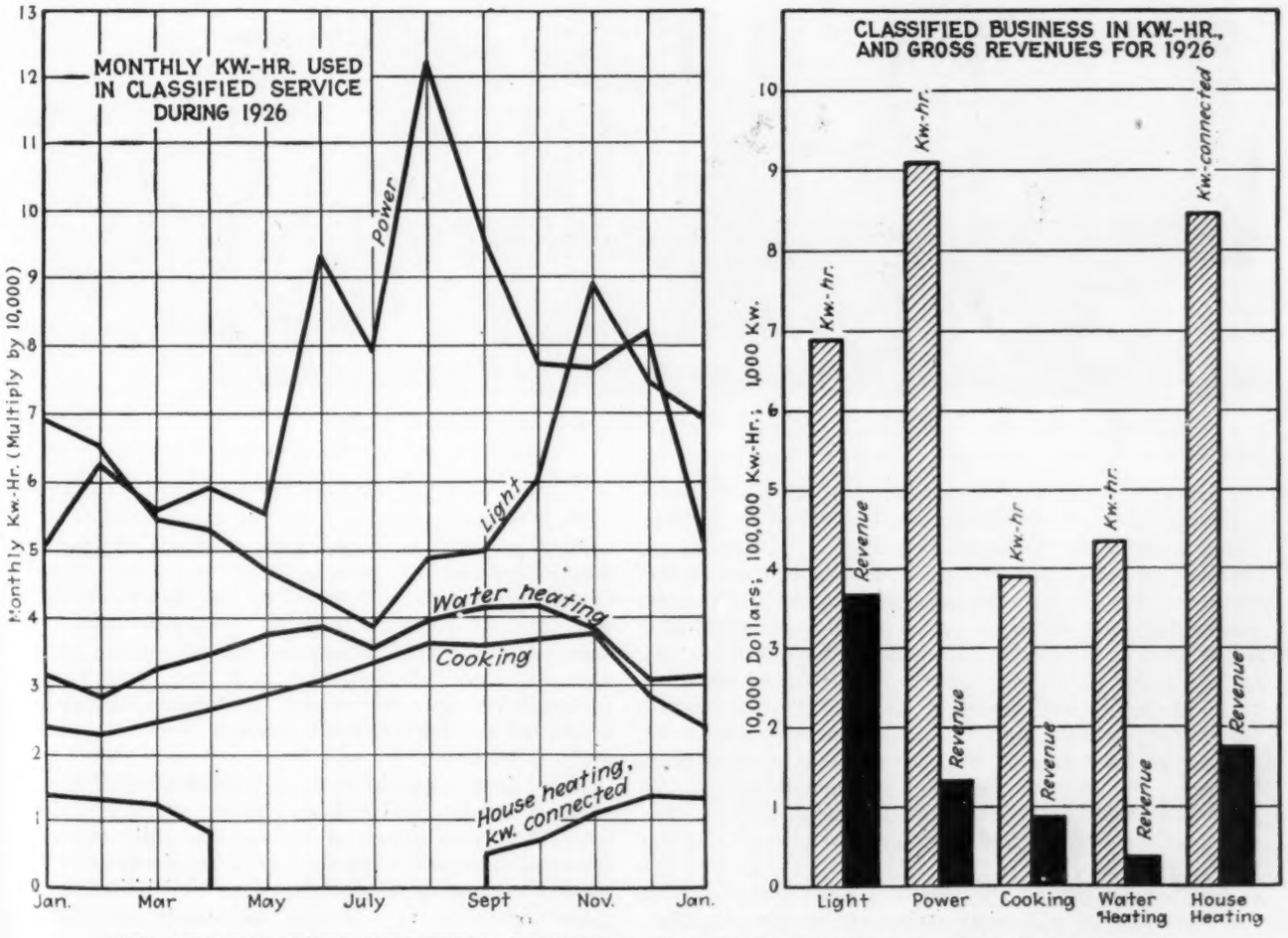
Power Rates.—Minimum charge $0.75 per horsepower. No charge less than $1.

Charge $0.05	per kw.-hr. for the first	100 kw.-hr.
0.04	per kw.-hr. for the next	100 kw.-hr.
0.03	per kw.-hr. for the next	300 kw.-hr.
0.015	per kw.-hr. for the next	500 kw.-hr.
0.008	per kw.-hr. for the next	1,000 kw.-hr.
0.007	per kw.-hr. for the next	3,000 kw.-hr.
0.0063	per kw.-hr. for the next	45,000 kw.-hr.
0.006	per kw.-hr. for the next	25,000 kw.-hr.
0.0057	per kw.-hr. for the next	25,000 kw.-hr.

Water Heating.—Minimum charge $0.50 per kilowatt connected load. No charge less than $1. Rate is $0.008 per kilowatt-hour.

House Heating is sold on a minimum of four consecutive months use and is based on the connected load.

1 to 3 kw.	at a rate of $2.50 per kw.
4 to 12 kw.	at a rate of 2.25 per kw.
13 to 20 kw.	at a rate of 2.00 per kw.
21 to 50 kw.	at a rate of 1.80 per kw.



POWER AND LIGHT REQUIRE MOST ENERGY AT BURLEY, IDAHO, BUT LIGHT AND HOUSE HEATING BRING MOST REVENUE

What the Girls Do for New Orleans Power Company

THE women's committee of the New Orleans Public Service, Inc., has formed an alumnæ association whereby each member when she leaves the company to be married receives a diploma. Whenever there is any special work to be done, such as during conventions, special appliance demonstrations, etc., these "graduates" are called upon to help out. Their response has been gratifying according to the women's committee and company executives.

The women's committee in New Orleans has been very active and has done a great deal of public relations and educational work, particularly among school students. Work in the schools was carried out in the following way: After winning the friendship of the local principals and teachers, invitations were issued by the company for an "open-house campaign" in its various plants. Up to date, more than 3,500 students have learned about their utilities, this number taking in more than 75 classes. At present the company is fostering an essay contest in the schools, awarding $300 in gold, and the papers already submitted are a revelation. The school work is handled entirely under the supervision of Miss Julie Pailet.

The inspection trips through the company's property are handled as follows: Representatives of the women's committee go to a school with two buses, and there Miss Pailet gives a short talk to the pupils on the policy of the company and an outline of what they will see on the inspection trip. Then the pupils are taken to the main generating plant of the company, to the gas plant and to the training school for motormen and conductors. At each of these places the features are described in terms that are readily understood by the students. From the training school, the pupils are transported back to the schools in the buses or they are let out at convenient corners. By the time the trip has come to an end the pupils enthusiastically cheer the company, and all persons residing in the neighborhood are well aware that the utility is active.

Another activity of the women's committee has been the formation of a 24-piece string instrument glee club, which plays for various local functions. During the recent flood period it assisted considerably in raising funds for the refugees as well as entertaining the refugees themselves. The club has grown so popular that it is necessary to perform two and three times a week to take care of all the invitations.

Six-Wheel Electric Hauls 100 Tons of Paper Daily

HEAVY traffic on the streets of Los Angeles, with many starts and stops, has furnished ideal conditions for a heavy-duty electric truck operated by the Los Angeles *Times* to demonstrate its flexibility and economy. The truck, which is shown in the accompanying illustration, is used for hauling newsprint from the warehouse to the newspaper plant, making from ten to fifteen 3.5-mile round trips per day with loads averaging ten tons apiece.

Average daily operating data indicate the following: Miles traveled, 13.8; ampere-hours per mile, 12.6; kilowatt-hours per mile, 1.7; energy required for charging the battery, 24 kw.-hr. The truck is a model N Walker truck originally of seven tons capacity, equipped with a 42-cell, 25-plate Exide-Ironclad battery. By the addition of the two rear wheels shown, making the truck a six-wheel truck, the loads carried were increased from five to ten tons without any appreciable energy consumption. This was partly due to a reduction in weight on the original rear wheels, reducing the tendency of the rubber on the tires to pile up due to the great weight and partly by reason of greater navigability due to shortening the wheelbase 18 in. at the time the truck was converted to a six-wheel truck. The two rear wheels are so connected with the steering mechanism that they turn with the front wheels, thus eliminating any tendency for them to be forced to slide on the pavement when the truck is making a turn.

ELECTRIC PAPER TRUCK PROVES ECONOMICAL IN LOS ANGELES TRAFFIC

This electric truck hauls in excess of 100 tons of newsprint daily for the Los Angeles *Times* and during more than four years of service has fully proved its dependability and economy. The requirements of the owners necessitate a high degree of reliability and sustained operation to maintain the supply of paper for the presses.

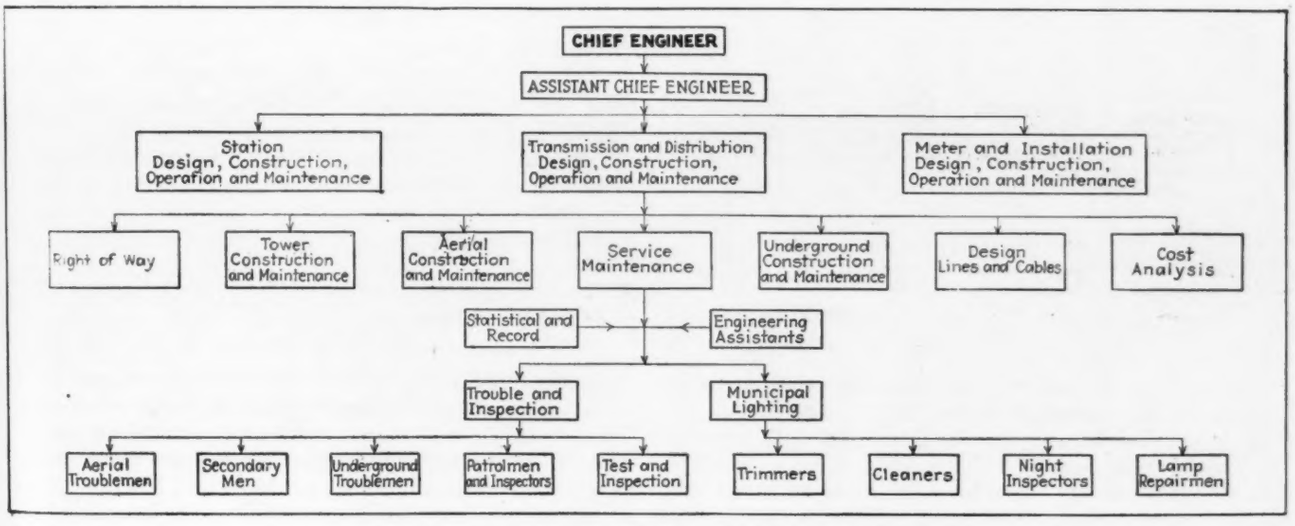
Service Maintenance

All operating divisions co-operate with the trouble dispatcher of the Philadelphia Electric Company to restore service. Nature of organization for co-ordinating this work. Repair men are trained for universal duty

By CARL D. BUCHHOLZ
Philadelphia Electric Company

A DEFINITE system of procedure designed to cover all possible sources and types of line trouble and service interruptions has been developed by the Philadelphia Electric Company. The plan is the result of careful investigation regarding the best way of rendering to all customers the best possible service with least delay.

For seven years we have had an organization that has met the requirements of our customers. The basic idea in the formation of this section was to assemble a group of employees with such experience and ability that men would always be available who were capable of restoring service, even though in a temporary manner. Our plan not only takes care of the customer's needs but also covers transmission, distribution and street-lighting trouble.



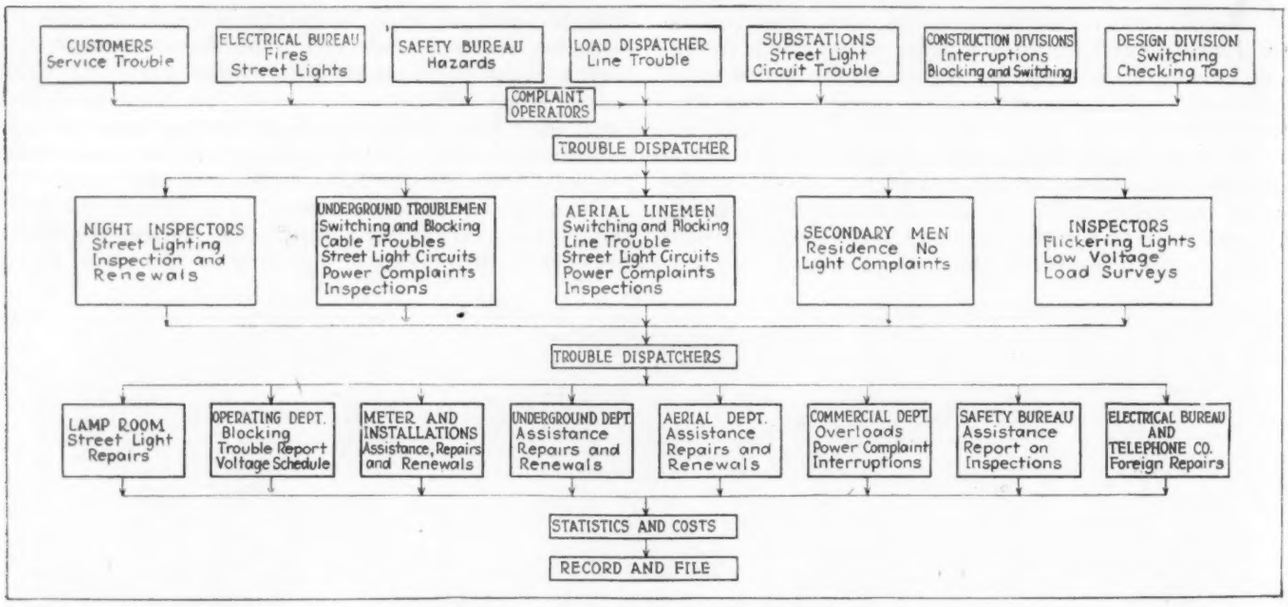
ORGANIZATION CHART OF SERVICE MAINTENANCE DIVISION

The development of a community depends, in a large measure, upon the service furnished by the utilities of that community, and the impression made by a utility upon its customers depends upon the manner in which its employees meet the customers. The service division must encounter the consumer under most adverse conditions, and when the personnel of this section realizes that the customer has the privilege of being out of sorts if his fuse blows, even though the customer himself is responsible, half of the battle to produce a favorable impression has been won.

The service maintenance division receives most of its calls from customers. These consist of such complaints as no light, no power, part of the house off, flickering light, low voltage, street lights out, wires down, cats on poles, accidents to poles, etc. The municipal electrical bureau supplies us with information regarding fire alarms, street lights out, wires down, accidents to equipment, etc. Our safety first bureau relays requests for inspection of equipment along highways or on customers' premises, referred to them by company employees. If an investigation proves existence of a hazard, the employees are given prize money as a reward for their vigilance, with the idea of fostering an interest in company property and preventing claims that might develop from such hazards. We employ young women to receive service calls, because we have found that they are inherently more courteous than men, work more quickly and produce neater records. In addition, the feminine voice has a decidedly soothing effect upon the customer and he does not say the things that he intended to say when his lights went out. All complaints received by these girls are time stamped and passed to the trouble dispatchers' receipt bin.

The trouble dispatchers receive direct reports of difficulties from the load dispatchers, substations, construction divisions and the design division. Load dispatchers supply requests for the operation of air-break switches and disconnecting devices for operating reasons and also refer all defective lines and cables to the trouble dis-

patchers. When a line, either aërial or cable, fails, the operating department, having made such tests as it deems to be necessary, refers the matter through the load dispatcher to the trouble dispatcher. The responsibility for locating and clearing the trouble and turning the line back lies with the latter. He is privileged to call on the construction division for assistance. The substations, which operate municipal street-lighting circuits, such as magnetite circuits, supply the trouble dispatcher with reports of trouble on such circuits. The construction divisions supply him with requests for interrupting service to customers supplied from 2,400-volt, 110 and 220-volt lines. They also request that arrangements be made for blocking and paralleling 2,400-volt circuits upon which they are to work. The underground construction division also requests the trouble dispatcher to arrange for blocking out any cable upon which they have work


CUSTOMERS Service Trouble
ELECTRICAL BUREAU Fires Street Lights
SAFETY BUREAU Hazards
LOAD DISPATCHER Line Trouble
SUBSTATIONS Street Light Circuit Trouble
CONSTRUCTION DIVISIONS Interruptions Blocking and Switching
DESIGN DIVISION Switching Checking Taps
COMPLAINT OPERATORS
TROUBLE DISPATCHER
NIGHT INSPECTORS Street Lighting Inspection and Renewals
UNDERGROUND TROUBLEMEN Switching and Blocking Cable Troubles Street Light Circuits Power Complaints Inspections
AERIAL LINEMEN Switching and Blocking Line Trouble Street Light Circuits Power Complaints Inspections
SECONDARY MEN Residence No Light Complaints
INSPECTORS Flickering Lights Low Voltage Load Surveys
TROUBLE DISPATCHERS
LAMP ROOM Street Light Repairs
OPERATING DEPT. Blocking Trouble Report Voltage Schedule
METER AND INSTALLATIONS Assistance, Repairs and Renewals
UNDERGROUND DEPT. Assistance Repairs and Renewals
AERIAL DEPT. Assistance Repairs and Renewals
COMMERCIAL DEPT. Overloads Power Complaint Interruptions
SAFETY BUREAU Assistance Report on Inspections
ELECTRICAL BUREAU AND TELEPHONE CO. Foreign Repairs
STATISTICS AND COSTS
RECORD AND FILE

PROCEDURE FOLLOWED IN HANDLING TROUBLE CALLS

to do, making the necessary arrangements for an interruption to any customer whose service will be cut off. The design division supplies the dispatcher with requests for transferring customers from one service to another, due to overload, etc., and also arranges with the dispatcher for the checking of transformer taps and nameplate data, should there be any question concerning these.

Allocation of Calls

All the work received by the trouble dispatcher is placed in district bins. These bins correspond to divisions which are covered by trouble men located at stations in these various areas. We have thirteen such stations, housing the service maintenance force. Some have three shifts, some two shifts, others only one shift. As soon as any man in a particular district is free he is assigned work from these bins. Hospitals, other public utilities and continuous-service customers receive preference in the assignment of complaint work. We have simplified the picking out of these complaints by having the complaint operator place those of the preferred list on salmon-colored cards, power customers on blue cards and residences on white cards. When the work is assigned to the trouble man, it is again time stamped and then placed in a smaller bin, designated as belonging to that particular man.

When the reports are received from the trouble man upon the completion of the job, he advises the dispatcher as to the exact time when the particular complaint was cleared. This is noted on the complaint cards, as well as a report of the work done, together with any expense, such as carfare or telephone calls, which the trouble man has incurred in clearing the complaint. The work card is then placed in the reference bin, awaiting a favorable opportunity to pass along to any other division that is interested.

Special Aërial Corps

In connection with the assignment of the work by the trouble dispatcher such details as refer to switching or blocking of circuits, line trouble, power customers' complaints, street-lighting circuit trouble and investigation of aërial equipment are assigned to aërial line trouble men. These men do not receive residence complaints except when all the secondary trouble men in their districts are busy. In connection with switching and blocking lines by the service maintenance division, it is interesting to note that all switches, aërial or underground, which are thrown out of their normal operating position by a trouble man are tagged with a red tag stenciled, "Danger —Call Trouble Dispatcher."

The complaints from residences, unless we receive a group of them from a particular neighborhood suggesting outside trouble, are assigned to secondary trouble men, a group that consists of boys between the ages of eighteen and twenty-five. Work relative to switching or blocking of underground circuits, cable trouble, underground street-lighting circuit trouble and underground inspections is passed to a group of underground trouble men. These men are qualified to cover all kinds of underground cable failures. They will locate a fault on a high-tension transmission cable or on a secondary cable. If the fault is but a slight burn, they are qualified to make repairs, even though it involves the remaking of a 13,200-volt splice, if that is necessary to restore service. Work rela-

tive to street lights is handled by a group of inspectors, who replace the lamps or cut out defective equipment. Work relative to flickering lights, low voltage, transformer load tests or load surveys is handled by a group of men qualified to cover any work of this nature.

When the street men have completed their work, the trouble dispatcher is advised as to what has been done and what it is necessary to do in order to complete the work and place it in permanent operating shape. The dispatchers pass this information along to the various divisions verbally.

The load dispatcher for the operating department receives reports of trouble and requests for the changing of circuit schedules, paralleling or blocking circuits. The meter and installation department is called upon to make permanent repairs or renewals and from time to time is also called upon to assist us in clearing trouble inside of the customers' premises. The underground division is called upon for assistance in drawing and splicing cable when the fault is located in the stretch between manholes. They are also called upon for repairs that the trouble force cannot make in a permanent manner.

The aërial lines construction division renders assistance in storms or times of abnormal trouble and is also called upon to make permanent repairs. If a high-tension line should be down, the trouble man will replace it with the heaviest wire he has on his trouble wagon at the time, in order to restore the line to operation. The aërial lines construction force is requested to make permanent repairs whenever it is convenient to take the line off for that purpose. This force is also called upon to replace burned-out transformers, the trouble man having cut the bad transformer clear of the line and transferred the load to an adjacent transformer.

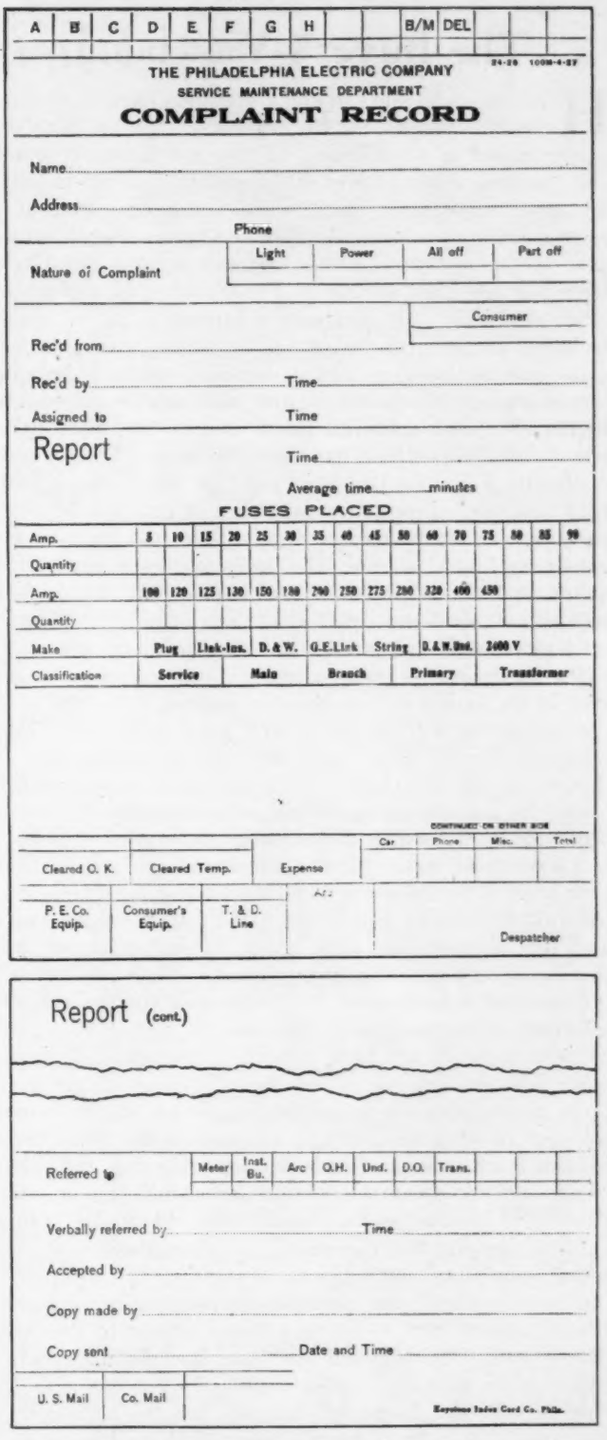
The commercial department is called upon for assistance in obtaining interruptions to 2,400-volt or low-tension customers. It is also consulted on the questions of policy that crop up from time to time. The safety first bureau receives reports on such inspection requests as it has forwarded to us. The municipal electrical bureau and the telephone companies receive reports from us relative to any of their equipment that we find to be in trouble. This consists chiefly of wires down.

After the work has been referred to the various divisions, it is confirmed to these divisions in writing. The work then passes on to the statistical division and from there to the files, where it is kept for a year.

Special Provisions

In connection with customers' troubles, the service maintenance division makes every effort to restore service, if necessary, in a temporary manner. We attempt to find out which house branch is giving the trouble and cut that branch out of service. The customer is referred to an electrician for permanent repairs. If a transformer burns out, it will be cut clear of the line and the load transferred to an adjacent secondary, if possible. If this is not possible and the transformer be a 10-kva. or smaller, it will be changed by this division. If it is of a large size and cannot be cut over, we put in its place a 100-kva. transformer mounted on a truck and arranged for this particular purpose, until such time as the aërial lines division can change the transformer. If a wire is down, the trouble man either puts it up or, if it is of too large a size for one man to pull, replaces it with smaller wire, restores service and refers the matter to the aërial lines division for permanent repairs. If a cable fails and repairs can be made by the trouble man in a temporary way, he does so. If not, the underground cable gangs are called out any time of the day to assist in restoring service. If trouble should occur in power customers' equipment resulting in idle workers, we make repairs for the customer if we can. A separate work order is taken covering such work for each division that may be called upon to render assistance and the cost forwarded to the commercial department for collection.

Our basic idea is to restore service with a minimum of inconvenience and annoyance to the customer under every possible condition.



THE PHILADELPHIA ELECTRIC COMPANY
SERVICE MAINTENANCE DEPARTMENT
COMPLAINT RECORD

A | B | C | D | E | F | G | H | B/M | DEL

Name
Address
Phone
Nature of Complaint: Light | Power | All off | Part off
Consumer
Rec'd from
Rec'd by ... Time
Assigned to ... Time
Report ... Time
Average time ... minutes

FUSES PLACED

Amp.	5	10	15	20	25	30	35	40	45	50	60	70	75	80	85	90
Quantity																
Amp.	100	120	125	130	150	180	200	250	275	280	320	400	450			
Quantity																
Make	Plug		Link-Ins.	D. & W.		G.E.Link		String		D.&W.Ind.		2400 V				
Classification	Service			Main		Branch			Primary			Transformer				

CONTINUED ON OTHER SIDE

Cleared O. K. | Cleared Temp. | Expense | Car | Phone | Misc. | Total

P. E. Co. Equip. | Consumer's Equip. | T. & D. Line | Despatcher

Report (cont.)

Referred to | Meter | Inst. Bu. | Arc | O.H. | Und. | D.O. | Trans.

Verbally referred by ... Time
Accepted by
Copy made by
Copy sent ... Date and Time

U. S. Mail | Co. Mail

Keystone Index Card Co. Phila.

RECORD SHOWS COMPLETE REPORT OF EACH TROUBLE CALL

The card reproduced above offers a detailed account of the origin and disposition of any complaint call and eliminates conjunctional records of material.

The Buyer's Viewpoint

HOW much latitude should a salesman have to produce the best results for his company? What does the buyer expect in a salesman? These are questions which the executive must answer satisfactorily in order to build up an effective sales force. The frank viewpoint of a central-station engineer as expressed herewith calls attention to the inability of the engineer to deal effectively with the salesman, except as a transmitter of the home-office decisions. In questions regarding price or minor technical changes this buyer has found the average salesman to be unable to make any decision, evidently because the salesman is not taken into the confidence of the home office and does not know exactly the basis upon which his proposition has been figured. This is undoubtedly a serious handicap and one which has a two-fold reaction. First, the buyer cannot get prompt decisions having all the flavor of definiteness to build up his confidence, and, second, the salesman is always in a quandary as to what is the lowest price the home office will accept, with the result that sales offices tend to sell on a price basis rather than sell their products on merit.

In discussing the sales situation, one company states that in its experience most sales engineers are not only not engineers but not even very good salesmen. This company further says: "It has always appeared to us that it was the function of the salesman to know as much about the apparatus, equipment or commodity that he is selling as it is possible for anybody to know. This does not necessarily mean that the salesman must always have first-hand information. The method of gathering this information would depend upon the individual salesman and the organization with which he is connected, but there is no doubt that the salesman could obtain this information if he desired to. Unfortunately, the average salesman or sales engineer does not do that. As a rule, he is content to act as a messenger between his home office and the customer whom he calls upon. Sometimes he is a very pleasant messenger, ready to take his client to lunch or offer him a cigar, but seldom has he any real idea as to what the product is that he is offering, the points of strength or weakness of his apparatus, how it compares with his competitor's equipment and similar points.

"It is obvious that the return to the engineer who may spend some time with him in discussing his equipment can be very small, and under those conditions the incentive to talk to him is brought down almost to the vanishing point. Occasionally, we have had the unexpected pleasure of meeting a sales engineer who was actually able to talk our language, but this has been altogether too rare. We have found again that salesmen, and sometimes good salesmen, and perhaps good engineers, who have to handle a proposed transaction were tied down by the factory or the home office so rigidly that they could virtually do nothing but act as transmitters of the home-office decisions. This again has always appeared to us as a mistake. It has always seemed that a far better arrangement would be for the local salesman or sales engineer to know exactly the basis upon which his proposition has been figured down to quite close details. With such a knowledge, and assuming that he is of the proper caliber, it ought not to be a very difficult matter for him to make a quick adjustment of his proposition to meet some minor change in specifications or change in features desired, etc. A decision in matters like this is sometimes needed in a hurry, but only rarely have we found a salesman who handled the proposal with enough leeway granted him by his home office executives to be able to go ahead and make a decision on his own initiative."

Letters from Our Readers

Secondary Circuits and Their Types

To the Editor of the ELECTRICAL WORLD:

Your editorial comment at the end of Alex Dow's article on "General-Purpose Secondary Circuits," in the Sept. 3 issue of the ELECTRICAL WORLD, sounds misleading to me. By that I mean it leads one to believe that Mr. Dow is discussing the merits of secondary networks. Mr. Dow takes great pains to state that he is not discussing the merits of secondary networks, but rather the feasibility of various types of secondary combinations, namely, five-wire, two-phase; four-wire, three-phase, and three-wire, single-phase.

While it is true that a discussion of four-wire, three-phase secondaries usually means secondary networks, you will note that in summing up his article Mr. Dow states in conclusion:

"1. I have said nothing adverse to a network or in favor of radial secondaries. To the contrary, I recognize the merits of the network as does every old Edison man.

"3. In discussing networks and 120-volt lamps as if these were attributes solely of the four-wire, three-phase circuit, some of the advocates of that form of secondary have beclouded the issue."

W. S. SCHMIDT,
Assistant Chief Engineer.
Pennsylvania-Ohio Power & Light Company,
Youngstown, Ohio.

* * * *

Why Not "Telorama"?

To the Editor of the ELECTRICAL WORLD:

In your issue of May 21 C. L. Kasson criticises the word "television," and in your issue of July 16 H. I. Mandolf defends it. I also criticise the word, but not from the viewpoint of Mr. Kasson.

I believe the word "television" is poor principally because it is crudely made up of two inharmonious words taken unnecessarily from two languages. "Tele" is Greek; "vision" is Latin. It would be much better widely to adopt the word that is a companion for "telephone" and "telegraph," both of which are pure Greek, viz., "telorama." "Tele" in Greek means "distance" and "orama" in Greek means "to see"; therefore telorama means distance-seeing. We have, then, words that meet with the approval of the lexicographer for "afar-writing," "afar-speaking" and "afar-seeing." The three words, "telegraph," "telephone" and "telorama," should be used broadly, in a perfectly parallel manner. However, we properly speak of "telephone apparatus" and "telegraph apparatus," and when telorama apparatus is also associated with the simultaneous reproduction of sound the combined instrument could very appropriately be called the "teloramaphone."

The word "television" should be abandoned at once. Already the public has heard it too often, but the public should now hear, as soon as possible and as often, and then some, the word "telorama."

Moore Laboratory,
Harrison, N. J.
D. MCFARLAN MOORE.

Digest of Electrical Literature

Generation, Control, Switching and Protection

Simplified Remote Control.—K. Rose.—The numerous switches of a modern power distribution center, with their "open" and "closed" signaling lamps, require a complex wiring system for remote control. Attempts to minimize the number of control wires between the sending and receiving station have been directed toward simplification and a reduction of installation cost. The author describes a method whereby the connecting lines may be reduced to about one-sixth of the customery number. The operation of the arrangement is based upon placing two relays in series at the receiving end, the first of them actuating a selector switch for the second. For a large number of switches the selector switch is replaced by a synchronous motor-driven selector drum at both ends, similar to that used in the American supervisory plan. A typical wiring diagram indicates the operation of this new system. — *Elektrotechnische Zeitschrift,* Aug. 4, 1927.

Earthing Systems. — Several suggestions for the construction of grounding installations at generating stations and substations are made in conjunction with an endeavor to illustrate the desirability of increasing the efficiency of grounding or reduction of resistance. No particular advantage is discerned in the use of copper for earth plates instead of galvanized iron, as copper may have to be tinned to prevent corrosion and iron rust does not appreciably increase the resistance to the earth. Periodic tests for resistance are advocated, and it is stated that they should be made by disconnecting each ground plate in turn and testing it in connection with the others. This will give a figure which may be compared with previous tests and will show whether the ground is still sound and efficient.—*Electrical Review (England)*, Aug. 19, 1927.

Transmission, Substations and Distribution

Hollow Conductors for High-Voltage Transmission.—M. F. Dahl.—If corona losses are to be kept at a minimum, the diameter of copper cables for voltages in excess of 110 kv. becomes so large that hollow conductors become an economic necessity. A variety of such tubular cable designs have been developed, all having a double layer of concentrically arranged conductors, with or without a central rib construction. The cable type, consisting of two layers with a twisted copper ribbon in the center, has become particularly popular. The author enumerates a number of disadvantages of these hollow cables, such as high manufacturing cost, compression of the inner layer, irregular surface due to unavoidable variations in the dimensions of the individual strands, tendency to open when cut, etc. All of these disadvantages can be overcome with a single-layer hollow cable, composed of interlocked wires and requiring no central reinforcing member. The appearance of the conductor is absolutely smooth, the construction does not tend to open at the end, rupturing strength is uniformly distributed upon all members of the cable, the weight is reduced, and the manufacturing cost is 15 per cent lower. Mechanical tests show high bending, crushing and rupturing strengths. Compared with twin layer cables, great savings can be achieved on long transmission lines operating at 220 kv. or 380 kv.—*Bulletin de l'Association Suisse des Electriciens,* July, 1927.

Rain Tests on Insulators.—E. Lienhard.—A report of data derived from laboratory tests, made with six types of high-voltage porcelain insulators, in connection with their flashover voltage when subjected to artificial rain. Results indicate that the conductivity of the water used, and the period of spraying both influence the time required for initial flashover. Tests show that the flashover voltage gradually drops as the flashes are repeated until a stationary value is obtained. Differences up to 30 per cent were found between the first and the final constant flashover. The data are tabulated and plotted. All tests were made with 0.1 in. rain per minute, falling at an angle of 45 deg. from a nozzle under a pressure of 45 lb. per square inch.—*Bulletin de l'Association Suisse des Electriciens,* July, 1927.

Units, Measurements and Instruments

Experimental Measurement of Mechanical Forces in Electric Circuits.—J. Walter Roper.—A relatively simple laboratory method for measuring the mechanical forces exerted on the parts of a complete circuit due to current flowing in the circuit is described by the author. In certain tests made with this apparatus and using the method described in the text the theoretical methods of computing such forces are shown to be reliable. Representative curves derived from the experimental data for the circular circuit and rectangular circuit are included and indicate the comparison of test results between the theoretical and measured forces.—*Journal of American Institute of Electrical Engineers,* September, 1927.

Determining Temperature Distribution.—A contribution to the evaluation of the flow of heat in isotropic media. By the use of integration and the calculus applied to the equation of thermal equilibrium, a determination of temperature and of its distribution, at different intervals following the establishment of a source of heat, is derived. The solution for a quantity of heat generated at a point taken as the origin of coordinates and diffusing into an infinite medium offers a basis for extension to apply to surface sources and other boundary conditions which are included by the method of images, or inversion, analogously with the electrostatic potential problem. The object of this article is to show that, given the solution for an instantaneous source, a solution may be deduced for a continuous source. The method has previously been suggested but has lacked extensive exploitation. — *Electrician (England)*, Aug. 19, 1927.

Illumination

Problems of Street Lighting by Electricity.—H. T. Harrison.—The author points out that in England very little advance has been made in street lighting and that the conditions are similar to those which existed more than ten years ago. It is his contention that the height, spacing and position of light sources should be rearranged to avoid the use of brilliant light spots and at the same time reduce the number of obstructions to vehicle and pedestrian traffic involving a potential danger to public safety. It is proposed that light sources be centrally suspended at frequent intervals by means of messenger wires, which, in order to reduce the cost and to simplify control and maintenance, should support the conductors. Various examples of overhead suspension are contrasted with the more usual method of supporting illuminating street-lighting fixtures by means of columns. Modern gas-filled electric lamps, owing to their light weight and small attention requirements, are particularly suited for the suggested mode of support and when combined with the necessary conductors need not be unsightly. Figures relating to the initial cost and operating expenses of the construction proposed by the author are given and compared with the existing examples. Highway and road lighting are considered, and it is suggested that this class of roadway be elluminated by means of highly concentrated light sources fixed at a considerable height to give the required vertical illumination, but so arranged that no illuminative effect is required from the adjacent source, thus reducing glare. — *Paper presented to Institution of Electrical Engineers (England)*, August, 1927.

Electric Lighting of Pullman Cars.—H. Grob.—A detailed description of the new German equipment, which is now being introduced as standard, to supersede the former gas lighting. The generator

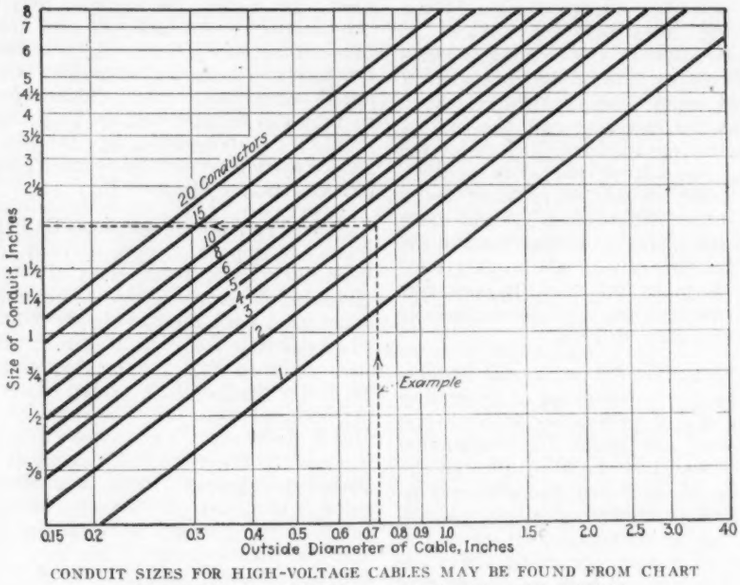
is of the shunt type, with the field regulated automatically by a series carbon pile. Its disks stand under permanent spring compression, while a voltage-controlled magnet tends to counteract the spring with rising potential. A variation of resistance within one to fifty is thus obtainable. A second current-controlled carbon pile is placed between generator and lamp circuits. A double-throw, double-pole switch connects the lights either to the generator and the battery during train run or to the battery alone at standstill. Among the many advantages claimed for this system is the usually small energy consumption of the regulating apparatus, permitting economical use on the smaller cars. It is also stated that the type of carbon disks used prevents breaking due to local overheating.—*Elektrotechnische Zeitschrift*, July 28, 1927.

Heat Applications and Material Handling

Rational Design of Structural Steel Joints for Arc-Welded Connections.—A. M. CANDY.—Joints which have been designated by the author as rational in design are not necessarily the last word in good practice in his estimation. They are simply suggested joints and are departures in most cases from what is found to be the practice in riveting construction. Endeavor has been made to have designers think in terms of welding rather than in terms of riveting. The results of numerous tests upon more than 40 speciments which were loaded to destruction indicate the value of the proposal suggested by the author. Many different methods of joining plates to girders and girders to columns and to each other were devised and tested. The author concludes: that arc-welded joints can be constructed in such manner as fully to develop the ultimate strength of the structural members connected; that beams and girders can be connected to columns so as to produce absolute fixation; that lines of beams or girders can be connected so as to provide complete continuity across the support, whether the support be girders or columns; that a steel I-beam of given section and length will sustain a far greater load if fixed at its ends by a suitably designed arc-welded joint than if supported by standard riveted connections consisting of top and bottom angles; that a plate girder assembled by welding and consisting of nothing but sheared plates has a far greater bending strength than a riveted plate and angle girder of the same weight, owing to the better distribution of the steel in the cross-section, and that a double-angle tension member such as is used in trusses connected at the ends by welding will, when tested to tension failure, break at the angles under a load 30 per cent greater than the load at which a hanger consisting of the same size angles with riveted connections will fail. It is stated that complete continuity of lines of beams can be obtained by welded construction.—*Engineers and Engineering*, August, 1927.

Motors and Control

Wiring for Motor Installations.—GORDON FOX.—The procedures involved in the proper wiring of motor installations in accordance with the code requirements and recommended practices with respect to conduit work and wiring considerations are discussed. The proper size of wire or cable to be used for various currents and the rules which must be applied in order to determine these sizes are given. Recommended practices for motor wiring in regard to cable capacity as related to the location of the controller and to the type of motor used and its size have also consideration. Conduit dimensions, for



CONDUIT SIZES FOR HIGH-VOLTAGE CABLES MAY BE FOUND FROM CHART WHEN SIZE AND NUMBER OF CONDUCTORS ARE KNOWN

different-sized cables up to 1,000,000 circ.mils and with varying numbers of conductors for securing the necessary wire area, are tabulated.—*Industrial Engineer*, August, 1927.

Telegraphy, Telephony, Radio and Signals

Further Investigation of Synthetic Galena Detectors and a New Theory of Crystal Rectifiers.—W. OGAWA, C. NEMOTO AND S. KANEKO.—The authors have investigated the various metallic sulphides and have found no definite relation between sensitivity and composition. Synthetic and natural galena have been compared and the results and relative efficiencies stated. Following a review of the various theories, designated as electrolytic, electrothermal and electronic unilateral conductivity, it is proposed by the authors that the electron-emitting faculty of the surface layer of each electrode and the electron-receiving faculty of each electrode be the main basis for the discussion. They conclude that to obtain good rectification the difference of the electronic characteristics of the electrodes must be as large as possible, that the resistance of the electrode must be great enough to minimize metallic conductivity but must not be so great as to retard the passage of electrons, especially at the anode, and that the contact pressure and area must be small enough to minimize metallic conductivity. With a soft crystal a light contact is necessary.—*Researches of the Electrotechnical Laboratory (Japan)*, 1927.

Insulation and Short Waves.—C. F. FORBES-BUCKINGHAM.—The author is primarily concerned with a search for the ideal insulator for radio equipment, but the apparatus and methods used in testing material are of value for testing dielectrics to be used with any high-frequency current. The difficulties in controlling oscillation and the effect of loading upon ebonite have received particular attention.—*Electrician (England)*, Aug. 12, 1927.

Miscellaneous

Burglar Alarm with Semi-Conductor Circuit.—W. BLUT.—This article describes an apparently newly discovered fact, namely, that electric circuits up to 200 volts potential can be carried through practically non-conducting materials, like dry wood, cloth, strings, paper, etc. While the resulting current does not exceed a small fraction of one-millionth of an ampere, certain attractive effects between wooden disks can be realized, and the latter can be made to operate electric alarm circuits. In connection with a specially developed electromagnetic holding relay, installations of burglar alarms for banks, stores, etc., have been made, which have proved positive and effective. The author emphasizes the fact that this new system has nothing in common with the well-known Johnson-Rahbeck effect, which deals with currents of at least ten times greater magnitude.—*Elektrotechnische Zeitschrift*, June 16, 1927.

News of the Industry

Upper Colorado States Repeat Proposal

But California and Arizona Are Still at Loggerheads—California's Suggestion for Division of Water Awaits Sister State's Reply

REPRESENTATIVES of the upper basin states at the seven-state Colorado River conference, which reassembled at Denver on Sept. 19, offered what they hoped would be a solution to the apparent deadlock between Arizona and California with reference to the allocation of the waters of the river. The proposal is the same as was submitted to the conference on Aug. 13. It provides as follows: That Nevada shall receive 300,000 acre-feet of water, that Arizona shall get 3,000,000 acre-feet and California 4,200,000 acre-feet from the total of 7,500,000 acre-feet delivered at Lee's Ferry by the upper basin states. The proposal further sets forth that Arizona shall receive 1,000,000 acre-feet from her tributaries and that water from tributaries in the lower basin states shall be the property of the state where it originates until it reaches the main stream. California delegates objected to the provision whereby less than 4,600,000 acre-feet of water was allotted to their state. When California's reply to the proposal was read, Arizona delegates branded it as an ultimatum and declined to make public their answer to the upper basin proposal without further careful consideration.

Bitterly opposed to the Swing-Johnson Boulder Dam bill, Arizona delegates fear that acceptance of the proposed water division would result in the passage of the bill; therefore they are expected to refuse to ratify the pact until the power question has been settled. California and Arizona were asked by the upper basin states to accept the division of the water for a period of twenty years, the question now at issue between them to be settled by arbitration at the end of that time.

At the initial meeting of this session Governor George H. Dern of Utah made the flat and unqualified declaration that he approved of California's conditional ratification of the Santa Fe pact. The Governor also approves Arizona's demand that she get revenue from Boulder Dam equal to what she might derive if the development were made by private capital. Governor Hunt of Arizona said that he believes California to be playing a waiting game in the belief that the Swing-Johnson bill will be passed at the next congressional session, but added in the emphatic language of men in argument: "They will have a hell of a time passing it." He said further that his state would not recede from its present position and that its demands for water are now at an irreducible minimum.

Improved Outlook for Export of Maine Power

A hopeful outlook for the exportation of surplus power from Maine was in evidence at the quarterly meeting of the New England Council last week at Poland Spring, Me., when Governor Brewster of that state intimated that if proper safeguards are furnished to insure the primary use of available hydro-electric energy in Maine, exportation may be attainable along the lines of an interstate compact. The Governor expressed himself as thoroughly opposed to federal control of power supplied from Maine, but did not declare himself in favor of the repeal of the Fernald law, under which exportation has been prohibited for the past eighteen years. In an introductory address, President John S. Lawrence of the council said that a committee including representatives of the power industry is now at work drafting a proposed basis of agreement for power interchange along the lines of an interstate compact which may be subject of legislation in Maine, New Hampshire and Massachusetts.

Progress in stimulating industrial development in New England through the co-operation of electric service companies was described in a report of a committee headed by Charles L. Edgar. Out of fifty-three companies replying to an inquiry, eleven are carrying on industrial development activities.

Commercial Director for N. E. L. A.

Executive Committee, Meeting in Chicago, Establishes This Office —Next Convention Will Be Held at Atlantic City on June 4 to 8, 1928

NATIONAL co-ordination and advisory direction of the merchandising and energy sales efforts of electric utility companies were decided on by the executive committee of the National Electric Light Association in session in Chicago on Wednesday, Sept. 21. The committee voted to create an office in national headquarters to be occupied by a man whose duty might be stated as the dissemination of sales information to and the arousing of sales enthusiasm in member companies through the channels of the existent geographical division and state commercial committee organizations.

The need for such an agency has been keenly felt in the last few years as appreciation of the commercial factor in the electricity supply business has grown. The arguments of J. E. Davidson, chairman of the Commercial National Section, for the establishment of this new office were ably seconded by Gerard Swope, president General Electric Company, and by men representing the geographic divisions.

That the next session of Congress will probably occupy itself rather largely with matters relating to and affecting the electric utility business was the general feeling observable in the committee meeting. This feeling led to much attention and discussion being given to matters of public relations and public policy. The report of the chairman of the Public Relations National Section, J. F. Owens; an address by W. A. Jones, N.E.L.A. representative on the joint utility committee on public policy, and remarks from others present emphasized the need for a true public conception of the electrical industry, and especially the urgent need of getting proper and adequate appreciation of facts before state and national legislators.

The address of Paul S. Clapp, managing director of the association, who has just completed his first year in office, also brought out these points very effectively. He repeated the words of Owen D. Young that the great problem confronting the industry does not lie in engineering nor in finance nor in commercialism, but in developing public understanding. Mr. Clapp pointed out that the national viewpoint on any question was the sum of local viewpoints and that the actions and attitudes of local companies in their home territories were the determinants in the national picture.

The Engineering and Accounting National Sections, in the reports of their chairmen, E. C. Stone and E. A. Davis, contributed to the public relations aspect of the meeting, the former by its formation of a sub-committee to aid in setting the engineering facts regarding certain fallacies, such as the cheapness of water power, before the public, and the latter by an enlarged interest in the work on those phases of accounting that concern the public.

On the motion of President H. T. Sands, the next convention of the association was set to be held at Atlantic City on June 4 to 8, 1928.

Pennsylvania-Jersey 220-Kv. Connection

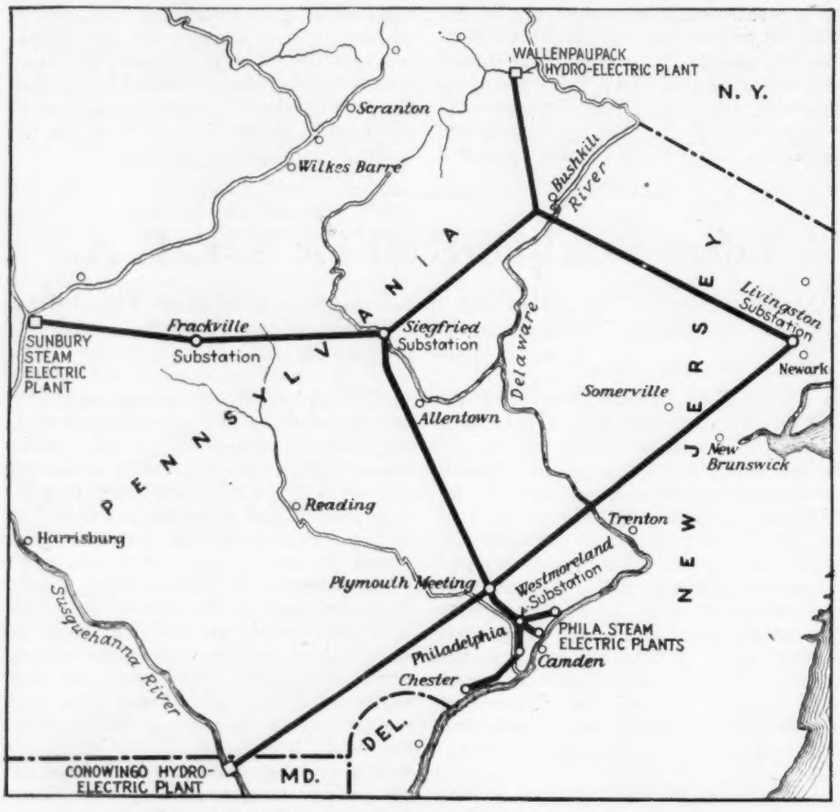
Signing of Contract by Philadelphia Electric, Public Service of New Jersey and Pennsylvania Power & Light Insures Superpower Over Dense Area

SIMULTANEOUS announcement on Sept. 16 by Walter H. Johnson, president of the Philadelphia Electric Company, and Thomas N. McCarter, president of the Public Service Electric & Gas Company of New Jersey, that they, together with Sidney Z. Mitchell, chairman of the board of directors of the Pennsylvania Power & Light Company, had signed a tripartite interconnection contract brought into the realm of fact the Pennsylvania-New Jersey "pool of power" foreshadowed last February at the time when the two Keystone State companies executed a dual contract of the same kind. As reported in the ELECTRICAL WORLD for Feb. 26 (page 467), the original tie-in formed a power pool roundly estimated at 2,000,000 hp. With the generating facilities of the Public Service company added, the new pool will contain ultimately perhaps 3,000,000 hp., serving a population of nearly six million persons. The total expenditure involved is put at $26,000,000, and 1930 is given as the date when the work will be complete.

In explaining to the public the reasons for the arrangement and the details of the plan Mr. Johnson said:

"The main policy actuating and guiding these companies in this undertaking has been the desire to render a service of greater reliability with improved economy of operation. The program is a very large one and will involve several years of construction work before it is completed. As the various sections of the line are completed they will be placed in operation immediately.

"The physical connection will be made over a 220,000-volt transmission ring more than 200 miles in circumference, with three major terminal substations at Plymouth Meeting, Pa.; Siegfried, Pa. (near Allentown), and Livingston, N. J. (near Newark). At Plymouth Meeting substation energy from the large steam plants of the Philadelphia Electric Company and the hydro-electric station at Conowingo will connect with the ring. The Pennsylvania Power & Light Company's hydro-electric and mine-mouth plants of east central Pennsylvania will connect with the ring at Siegfried. The modern tidewater steam plants of the Public Service Electric & Gas Company will connect with the ring just outside of Newark. No interconnection designed for the transmission of such large blocks of energy and involving companies operated by financially independent interests has ever before been attempted. It is estimated that there will be a saving in generating equipment of approximately 450,000 hp., resulting in a net saving of many millions of dollars.



TERRITORY IN PENNSYLVANIA AND NEW JERSEY TO BE SERVED BY 220-KV. INTERCONNECTED LINES

"While the benefit obtained through combining the diversified loads of the three companies is probably the most important and alone would justify the interconnection program, many other advantages are gained. Among these are the consolidation and staggering of the construction programs of the three associated companies, the greater total use of the high-efficiency stations and the corresponding decreased use of the less economical generating facilities, and the availability of all stations in the three systems to care for service in far-reaching and unexpected emergencies, such as breakdown of generating capacity, shortage of fuel and unforeseen increases in load.

"Construction has actually been started on the section of the ring connecting the Philadelphia Electric Company and the Pennsylvania Power & Light Company properties, which will be ready for operation early in 1928, while the construction of the section linking the Public Service company to the ring will be started later in the year.

"Plymouth Meeting substation, the point where the Philadelphia Electric Company is to tap the 220,000-volt ring, will be the largest single switching station in the world. This substation, which will be the terminus of the incoming and outgoing transmission lines, will cover an area of 40 acres. It is designed to control 750,000 kw. and will be one of the most interesting and spectacular parts of the interconnection program. The initial installation will consist of two 100,000-kva. transformer banks, each consisting of three single-phase oil-insulated, self-cooled units wound to step energy down from 220,000 volts to 69,000 and 13,300 volts."

NEW JERSEY PROGRAM

The statement given out by the Public Service Electric & Gas Company says that an 82-mile transmission line will be constructed from Siegfried to a switching station at Roseland, near Newark, where it will connect with lines from Kearny and other stations of the Public Service company. Eighty-foot steel towers spaced about 1,000 ft. apart will carry a single circuit of three conductors of approximately an inch in diameter. The Roseland and Philadelphia stations will be connected by a 77-mile line. The Roseland switching station will occupy a plot of about 40 acres and will cost between $5,000,000 and $6,000,000. Construction work will begin some time this fall.

Ratings of the three companies concerned are given by the Public Service company as follows:

	Kw.
Philadelphia Electric Company, present rating	570,000
Philadelphia Electric Company, Conowingo	250,000
Pennsylvania Power & Light Company	292,000
Public Service Electric & Gas Company	575,000
Total	1,687,000

This indicates an actual initial pooling of more than 2,000,000 hp. irrespective of auxiliary sources and additions in the near future totaling perhaps half as much again.

Pacific Coast Convention of A.I.E.E. Ends

Transmission at 220 Kv. and Lightning Protection Topics at Closing Sessions of Successful Del Monte Meeting—Spokane Next Meeting Place

IN THE two concluding technical sessions of the Pacific Coast A.I.E.E. convention, held at Del Monte, Cal., Sept. 13-16 (see last week's ELECTRICAL WORLD, page 576) able papers dealing with 220-kv. operating experience and associated apparatus and with the protection of oil-storage reservoirs from lightning were presented.

Transients due to short circuits were the subject of a paper prepared by R. J. C. Wood, L. F. Hunt and S. B. Griscom, in which the authors interpreted results of automatic oscillograph tests made on the Big Creek 220-kv. lines of the Southern California Edison Company. It was found that for loads below approximately 150,000 kw. for the two lines the probability of outage is very small and has been zero when the relay operation has been perfect. Speed of relay and oil-circuit-breaker operation was shown to be one of the most important factors in the ability of the system to maintain synchronism during transients.

In a paper on equipment for 220-kv. systems, J. P. Jollyman said that four years' experience has shown that 220-kv. transmission is as reliable as transmission at 110 kv. and much more economical. The importance of high insulation value was stressed as inhering not necessarily merely in the number of insulator units used but in the length of the insulator string because of its bearing on flashover distance. R. Wilkins and F. R. George gave performance data on the Pit River 220-kv. lines of the Pacific Gas & Electric Company in which it was shown that an average of four flashovers occur per year per 100 miles of circuit. The stability of a line depends upon four factors according to E. R. Stauffacher, high-speed relay operation, high-speed circuit-breaker operation, design of the generators, particularly as to short-circuit ratio, and the application of quick-response excitation to generators.

The Baum principle of increasing the static stability of a transmission line by the use of intermediate synchronous condensers was dealt with in a paper by R. D. Evans and C. F. Wagner and demonstrated by a mechanical analogy. This paper aroused keen discussion.

Synchronous-condenser characteristics and design were discussed in a paper by P. L. Alger, who made a plea for imposition of the least possible number of fixed requirements upon the manufacturer to permit him to standardize on design.

At the final session of the convention, on Friday morning, four papers were given. The first, by J. W. Legg, covered the development and application of automatic oscillographic recording apparatus for obtaining field data on transmission lines under actual operating conditions. Results of a series of tests on high-voltage circuit breakers on the system of the Pacific Gas & Electric Company were presented in a paper by Roy Wilkins and E. A. Crellin. The importance of speed of break was forcibly brought out in the paper, and five features which in the opinion of the authors should be incorporated in the design of breakers were enumerated. Two papers dealt with the protection of oil-storage tanks and reservoirs from lightning. Tests made in the high-voltage laboratory at the California Institute of Technology and results from actual installation of protective systems were recounted by R. W. Sorensen, J. H. Hamilton and C. D. Hayward. The authors held that the radius of an area to be protected should not exceed two and one-half times the tower height. Calculations gave to them little indication that lightning may be prevented by conduction currents from points as proposed in one system of protection. E. R. Schaeffer outlined practices that have been used by oil companies. He advocated a grid or network of wires 12 ft. above the reservoir roof. In the discussion mention was made that a group of oil companies are conducting field tests to determine the protective value of steel towers. Steel masts were erected in the high mountains of central California early in the summer, but observers had no results to report.

The 1928 Pacific Coast A.I.E.E. convention will be held at Spokane, Wash., under the auspices of the Spokane Section.

Reorganization of S. E. D. in Effect

Freeman Remains as President—Heads of Industry Associations and of League Council Become Vice-Presidents—K. A. McIntyre Managing Director

MEETINGS held at the offices of the Society for Electrical Development in New York City on Sept. 15 consummated the plans already described in the ELECTRICAL WORLD by which a new relationship to the industry and a sound working basis for that society are provided. The outstanding feature of the arrangement now converted into fact is the election as vice-presidents and the presence on the board of directors of the heads of the four main associations of the industry —the National Electric Light Association, the National Electrical Manufacturers' Association, the Electrical Supply Jobbers' Association and the Association of Electragists International. The managing directors of these four bodies go on the new executive committee of twelve directors.

Another important action at last week's meeting was the appointment as managing director of the society of Kenneth A. McIntyre, who since January has been in charge of the staff in an acting capacity. The appointment of Mr. McIntyre was by unanimous vote of the executive committee, which at its meeting also formulated plans for immediate activities.

W. W. Freeman was again chosen as president of the society, and at the directors' meeting which followed the members' meeting an engraved testimonial in appreciation of his services was presented to him. In referring to the successful completion of the reorganization plans Mr. Freeman paid tribute to the co-operation received from the leaders of the national associations—Messrs. Sands, Swope, Cullinan and Chamblin—and the chairman of the League Council, J. E. North. He also said that the refinancing of the society by means of a bond issue was virtually complete.

The officers, executive committee and board of directors of the society, as confirmed at the meetings, are as follows:

President—W. W. Freeman.

Vice-Presidents — George E. Cullinan, chairman executive committee, E.S.J.A.; C. L. Chamblin, president A.E.I.; J. E. North, chairman League Council; Gerard Swope, president N.E.M.A.; Howard T. Sands, president N.E.L.A.

Executive Committee — C. L. Edgar (chairman), president Edison Electric Illuminating Company, Boston; L. W. Davis, general manager association of Electragists; D. C. Birdsell, League Council, Philadelphia; George E. Cullinan, vice-president Graybar Electric Company; J. E. North, chairman League Council; Paul S. Clapp, managing director N.E.L.A.; S. L. Nicholson, acting vice-president Westinghouse Electric & Manufacturing Company; A. E. Waller, managing director N.E.M.A.; Frank S. Price, president Pettingell-Andrews Company, Boston; James R. Strong, president Tucker Electrical Construction Company, New York; James H. McGraw, president McGraw-Hill Publishing Company, New York; C. A. Ward, president Ward Motor Vehicle Company, Mount Vernon, N. Y.

Board of Directors—To represent central-station group: H. T. Sands, J. E. Davidson, P. S. Clapp, W. W. Freeman, C. L. Edgar and J. F. Gilchrist; to represent manufacturer group: Gerard Swope, A. E. Waller, S. L. Nicholson, W. E. Sprackling, F. R. Farmer and H. B. Crouse; to represent jobber group: G. E. Cullinan, F. S. Price, O. F. Rost, B. E. Finucane and W. I. Bickford; to represent contractor-dealer group: C. L. Chamblin, L. W. Davis, W. C. Peet, J. R. Strong, J. A. Fowler and C. M. Beltzhoover; to represent "at-large" group: J. R. Crouse, J. H. McGraw and C. A. Ward; to represent local electrical leagues: J. E. North, H. A. Brooks, R. B. Corcoran and D. C. Birdsell.

Arc Welding Prominent in Proceedings of A. W. S.

The American Welding Society met at Detroit on Monday to Friday of this week. Coincident with this convention the American Society for Steel Treating, the Institute of Metals and the Society of Automotive Engineers held meetings in the same city. The National Steel and Machine Tool Exposition was also held at Convention Hall there.

Electric welding occupied a conspicuous place on the program of the American Welding Society. G. R. Brophy, discussing metallurgical obser-

vations, attached particular importance to the quality of the steel welded as affecting the strength of welded members. Comparative tests indicated that metal deposited in arc welding is being contaminated by a poor quality of plate. The relative advantages of various types of electrodes, improvement of welds by annealing and the metallographic structure of welds were considered.

Joseph Matte pointed out that the use of arc welding in buildings requires cooperation between the welder and the structural engineer. He traced the increased use of welding in structural steel work and described the methods used in a number of cases and the proposed welding program for a 25-story extension to the First National Bank Building in Detroit. Mr. Matte urged that welding engineers make a study of structural engineers' problems.

On Thursday a paper was to be presented by G. H. Danforth describing the construction of a completely arc-welded building recently erected at Derry, Pa. Particularly prominent at the National Steel and Machine Tool Exposition were electric heat-treating furnaces, welding apparatus, temperature-control equipment and a motion-picture film, "Electric Heat in Industry," exhibited by the N.E.L.A. industrial heating committee.

Feldmann I.E.C. Head

Next Meeting for United States—Americans Present Bust of Franklin—International Standardization Furthered —New Committee Formed

MEETING at Bellagio, Italy, on Sept. 12, the International Electrotechnical Commission's committee of action elected new officers as follows: President, C. Feldmann, Delft, Holland; honorary president, Guido Semenza of Italy, the retiring president; honorary secretary, Kenelm Edgcumbe of Great Britain, *vice* Sir Richard Glazebrook, resigned. The next meeting was fixed for the United States in September, 1928. In 1930 the conference will go to Stockholm.

Reports from the advisory committees of the commission were submitted to the committee of action before the delegates left Bellagio on Sept. 13 for their tour of Italian cities. These reports were to be finally acted upon at the plenary meeting of the commission in Rome on Sept. 22. At the banquet the Americans presented a bust of Franklin to the Italian committee.

A meeting of officers of the International Electrotechnical Commission, the International Conference on Large Electric High-Tension Systems, the World Power Conference, the International Tramway Union and the consultative committee of the International Telephone and Telegraph Association has agreed to recommend the formation of a co-ordinating committee to meet at infrequent intervals to compile data and prevent overlapping of efforts. The I. E. C. is to function as a clearing house for all these bodies, which will recognize it as the authoritative body for international electrical standardization. At a meeting presided over by Mr. Instrom of Sweden the international standardization movement was discussed informally.

A meeting of the "committee of seven" may be held in London at the end of November on account of the resignation of Sir Archibald Denny because of illness.

A new advisory committee has been formed to deal with electrical installations on shipboard, the secretariat going to Great Britain. To Italy has been assigned the secretariat on voltages, to France that on traction equipment, and to Great Britain that on the rating of electrical machinery. The United States has been asked to subdivide the work of the committee on prime movers into thermal and hydraulic.

"Engineering News-Record" Editor Dies

Frank C. Wight, editor of the *Engineering News-Record,* one of the McGraw-Hill publications, who had served that journal and its predecessor, *Engineering News,* in an editorial capacity for twenty-one years, died at his home in Summit, N. J., Sept. 18. Mr. Wight had been ill for only a week with an infected throat, though the fatal illness followed shortly his return to his desk after a nervous breakdown.

FRANK C. WIGHT

Born in Washington, D. C., Feb. 26, 1882, Mr. Wight studied at Columbian (now George Washington) University, and later at Cornell, where he received the degree of civil engineer in 1904. After graduation he spent three years in the office of the engineer of bridges of the District of Columbia. His entry into the field of technical journalism dated from December, 1906, at which time he became associate editor of *Engineering News.* In 1913 he was promoted to the managing editorship of that paper, a position which he held until it was consolidated with the *Engineering Record* in 1917. Four years later he became managing editor of the consolidated journal, the *Engineering News-Record,* and on Jan. 1, 1924, he was made its editor.

Mr. Wight, who was a man of brilliant attainments and broad understanding and sympathies, came into contact with the electrical industry where it touched the widely embracive field of civil engineering and especially in connection with hydro-electric development, where hydraulic construction is common ground. He was a member of the American Society of Civil Engineers and the Engineers' Club, and he had for years been active in the work of both the National Conference of Business Paper Editors and the New York Editorial Conference. Of the former organization he was president at the time of his death. He was a former chairman of the New York Editorial Conference.

Death of A. E. Clifford

Arthur E. Clifford of Wynnewood, Pa., business manager of *Automotive Industries,* published in Philadelphia, dropped dead in the Union Station, Cleveland, Ohio, on Tuesday night, Sept. 20. Mr. Clifford was for many years connected with the McGraw Publishing Company and its successor, the McGraw-Hill Publishing Company, Inc., as business manager of the *American Electrician* and the ELECTRICAL WORLD. In December, 1923, he resigned the position he then held as assistant to President James H. McGraw to join the business staff of *Automotive Industries,* at that time published in New York.

Mr. Clifford, who had been private secretary to the Adjutant-General of the United States Army, joined the ELECTRICAL WORLD about 1892 as business manager. The paper was then published by the late W. J. Johnston. In 1896 Mr. Clifford left that post to become business manager of the *American Electrician,* published by the McGraw Publishing Company, and he continued in that capacity until 1906. In that year Mr. McGraw, who in 1899 had purchased the ELECTRICAL WORLD, consolidated the two journals, and Mr. Clifford continued as business manager of the combined paper. In 1908 he was made second vice-president of the McGraw Publishing Company and assistant to the president.

Mr. Clifford was born in New Hampshire, but resided in Washington before his connection with the ELECTRICAL WORLD. He was about 59 years of age. Speaking of Mr. Clifford's death, Mr. McGraw said: "Both capacity and courage were conspicuous characteristics of Arthur Clifford, whose earnest and devoted work will long be remembered by those for and with whom he labored. A large number of friends in the McGraw-Hill Publishing Company and the United Publishers' Corporation, as well as in the other circles where he mingled, will miss him for his sterling personal and business qualities."

Purchases and Mergers

Far West, South, Middle West and East Represented in Week's List—Martinsville, Va., Refuses $400,000 for Its Plant

PURCHASE of the Potlatch Consolidated Electric Company system at Potlatch, Idaho, by L. M. Simpson and F. M. Shields of Spokane, Wash., is announced. The company has been incorporated as the Potlatch Power Company. The system serves Potlatch, Kenrick, Troy, Bovill and Deary, Idaho, with power purchased from the Washington Water Power Company of Spokane.

The W. B. Foshay Company has bought the Northwest Light & Water Company, which, with its main office at Spokane, Wash., serves Wallace, Idaho, and vicinity with electricity and water. The purchased company will be merged with the Public Utilities Consolidated Corporation.

The West Texas Utilities Company has purchased the electric light and power plants of the Quanah Ice & Light Company at Quanah and Chillicothe, and an improved transmission system will be installed.

Announcement is made of the purchase by the Southern Public Utilities Company of the Wilkesboro and Moravian Falls (N. C.) transmission lines and the power plant of the Moravian Power Company from S. S. Coachman of Clearwater, Fla., and J. T. Humphries of Moravian Falls. The company will build lines to Wilkesboro.

The Town Council of Martinsville, Va., has rejected a new offer made by the Appalachian Power Company to buy the town's electric power plant for $400,000. Last year the organization offered $300,000. Energy manufactured by the company operates several industrial plants in the town.

The Kentucky Utilties Company has purchased the light and power system at Caneyville, Ky. A 12-mile transmission line will be built from Leitchfield.

The Nebraska Power Company has purchased from the Central West Public Service Company the properties it operated at Bennington, Elkhorn, Waterloo, Valley, Le Shara, Yutan, Elk City and Hooper and taken over its contracts to supply at wholesale the municipalities of Mead, Colon, Washington, Kennard and Herman. It has also taken over properties of the Omaha & Lincoln Railway & Light Company near Omaha, where the Nebraska Power Company has its plant. These were formerly operated by the McKinley interests in connection with an interurban electric railway company, now discontinued.

Authority has been given to the Iowa Public Service Company to purchase for $30,000 the Luverne (Iowa) electric system by a vote of the citizens, 96 to 20, with a 25-year franchise.

An offer from the Iowa Railway & Light Corporation to pay $25,000 for the Roland (Iowa) municipal light plant and distribution system was rejected by the voters, 144 to 16.

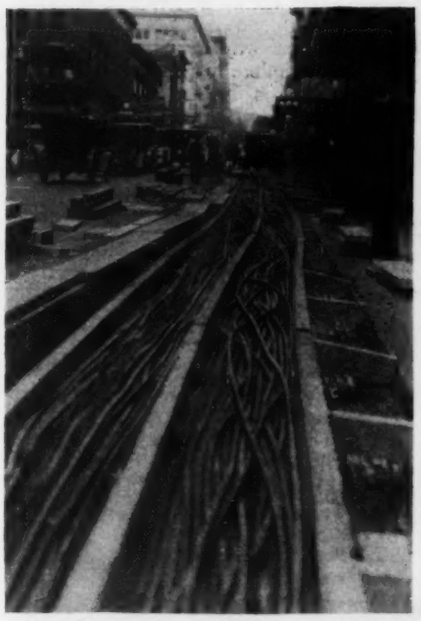
The M. B. Light & Power Company of Eaton and Morrisville, N. Y., has been sold to the New York State Gas & Electric Corporation.

Application has been made by the Staten Island Edison Corporation of St. George, Staten Island, to the Public Service Commission of New York for authority to transfer its franchises, works and system to the New York State Gas & Electric Corporation, which now owns 182,262 out of 182,725 shares of stock of the Staten Island Edison Company. The Staten Island company has franchises for supplying electricity in Edgewater, Port Richmond, Brighton and the towns of Northfield, Southfield, Westfield and Middletown.

Rapid Repairs at Portland

Twenty-four Hours Suffices to Restore Direct-Current Service Put Out of Commission by Storm in Oregon

REMARKABLE speed in effecting temporary repairs was recorded by the organization of the Portland (Ore.) Electric Power Company on the evening of Sept. 6, after a violent storm had put the entire direct-current underground system out of commission. A heavy downpour accompanied by an electrical storm blocked the sewer system, causing the run-off to back into a vault on the corner of Sixth and Alder Streets, one block from the Alder Street substation, which is the source of the underground system. Cable insulation, weakened largely by heat due to the proximity of a steam-heat line, broke down, "shorted" out and caught fire, destroying all connections in the vault and much of the cable radiating from it. Flames and smoke poured out from the manhole and persisted until subdued by the fire department.



WOODEN TROUGHS LAID ALONG CURB FOR TEMPORARY CABLES

The vault in which the fire occurred contained 31 250-volt direct-current feeders, five 11-kv., three-phase alternating-current lines, one 600-volt direct-current railway feeder, 24 secondary mains consisting of direct-current and single-phase and three-phase alternating-current lines, a 2,300-volt junction box, a number of service cables and a 30-pair telephone cable. The destruction of this equipment caused the worst breakdown in the seventeen years' existence of the direct-current underground system.

Temporary repairs were commenced immediately. In one hour and twenty minutes two 250-volt direct-current feeders, isolated from the rest of the system, were closed to supply service to two evening newspapers. Railway service was completely restored in two hours, while in less than three hours the direct-current service west of the substation and the alternating-current underground service was brought in. Temporary repairs were continued through the night, and by 10 o'clock next morning 80 per cent of the 250-volt direct-current service had been restored, while by evening virtually all service was back to normal.

Repairs were effected by tapping the 250-volt bus in the substation, bringing the cables out through the window across the sidewalk and down the curb line of the street to the manhole. These cables were laid in a wooden trough and covered to permit traffic to cross over them. Fifteen thousand feet of cable was used in this repair work. It was procured by combing the city for 500,000-circ.mil and 1,000,000-circ.mil rubber-covered and weatherproof wire. Permanent repairs, which will take three months to complete, will be effected by sinking a new manhole at Sixth and Alder Streets, but across the street from the old manhole, and tapping the circuits between the new and the old manholes.

Maryland Men Interested in Rural Service

Electrification of farms and rural districts was the principal topic discussed by the "electric group" at the midyear meeting of the Maryland Utilities Association, held in the State House at Annapolis on Sept. 16. Dr. R. A. Pearson, president of the University of Maryland, expressed the view that electricity may become the chief factor in reducing the cost of agricultural production, which it may revolutionize as it has industry. While economic considerations should be tempered by social obligation, he held none the less that a fair return for electric service from rural communities as a whole should accrue to the companies supplying it. The profits, however, should be put back in the rural field to build it up. Eugene Creed, Potomac Edison Company, read a paper on "Merchandising Policies in Rural Electrification."

A. M. Perry, associate editor ELECTRICAL WORLD, advocated the co-ordination of company activities and policies in

farm service, the establishment of rural service departments, the survey and classification of the local fields, planning adequately for reliable service including ample outlets and wiring, development of inducement rates, farm demonstrations with portable equipment, "experience meetings," and assistance of every possible kind to the farmer. The installation of "chore" and community motors should have consideration, he said, and it should be borne in mind that low-revenue uses lead to larger uses.

The papers were discussed by C. H. Leatham, R. H. Tillman, G. P. Mangan and F. N. Lawton.

In the evening a banquet was held at Carvel Hall, where the speakers were Governor Ritchie, Harold E. West, chairman of the Public Service Commission, and Thomas A. Daly, of the Philadelphia *Record*. The scramble of holding companies to obtain small, isolated utility plants of various kinds in Maryland and the willingness of some concerns to pay almost any price for them has become of vital concern to the Public Service Commission, Mr. West asserted. "The commission feels it has the power to protect utility customers from rates based on excessive prices paid for purchased utilities," he said. "In just what other ways the interests of the public may be affected is problematical. There may be hidden ills in the situation."

Arkansas Power & Light to Build New Line

Will Run from Sterlington, La., to El Dorado and Camden, Ark., 77 Miles, and Be Operated at 110,000 *Volts*

ANNOUNCEMENT was made last week by the Arkansas Power & Light Company that a 110,000-volt transmission line, together with five large transformers and switching stations, will be started immediately and completed within 60 days. A force of 650 men will be employed. Construction of a five-million-dollar paper mill by the Southern International Paper Company at Camden, Ark., has made the rapid construction of the line necessary.

The Louisiana Power Company, subsidiary of the Arkansas Power & Light, operates a 30,000-kw. gas-fired plant at Sterlington, La., on the Ouachita River, 20 miles north of Monroe, which is ultimately to be trebled in size. The new line will start at Sterlington, running to El Dorado, Ark., and thence to Camden. By this construction the Remmel hydro-electric station, Little Rock, Pine Bluff, Russellville, El Dorado and other Arkansas Power & Light Company stations will be permanently connected with the Sterlington plant. The new line will be 77 miles long. It will be strung on 50-ft. creosoted pine poles spaced nine to the mile. Two steel structures will be built at El Dorado and the same number at Camden to house the transformers, at a cost of $250,000, and a twenty-thousand-dollar switching station will be installed at Sterlington. The cost of the line, transformers and switching stations will be approximately $650,000.

Two additional 30,000-kw. units are already under construction at Sterlington, which when completed within the next twelve weeks will give the plant a total capacity of 90,000 kw., making it rank among the large generating plants in the South. Work on the new line will be under way by Oct. 1, and it is hoped to complete it by December. The right-of-way is 100 ft. in width, providing ample space for future lines.

Reports presented at a stockholders' meeting of the Arkansas Power & Light Company held at its Little Rock offices recently showed that the company's construction program is progressing rapidly and by the end of year will have involved an expenditure of $3,000,000. Besides the high-tension line just described, new construction includes a line from Newport to Batesville and a line from Little Rock to Morrillton.

Preliminary work on the second of the dams on the Ouachita River now is under way, although the site has not been definitely selected. This development, which will include a hydro-electric plant, will be supplemental to the Remmel Dam plant. Eventually a third dam will be built on the river.

BIRD'S-EYE VIEW OF STERLINGTON POWER STATION

Empire State Metermen Hold Two-Day Session

More than a hundred members of the Empire State Gas and Electric Association attended the annual meeting of the Electric Power Section held in Syracuse on Sept. 15 and 16, Chairman W. J. Consler of the Rochester Gas & Electric Corporation presiding. James C. DeLong, president of the Syracuse Lighting Company, delivered the address of welcome. Representatives of the leading American meter manufacturers and of one foreign concern addressed the meeting in connection with the developments in metering by their respective companies. The tendency toward greater accuracy, lighter weight and increased ease of adjustment and testing was stressed by all of these representatives.

Rural metering problems and the desirability of crew testing of this equipment were considered by L. K. Brown of the Depew & Lancaster Light, Power & Conduit Company. Prof. C. W. Henderson of Syracuse University recounted educational efforts on behalf of metermen. The qualifications, temperamental and educational, which meter testers should possess and the possibilities in this work for such men were developed in the paper of E. E. Hill, New York Edison Company, which was read by A. F. Kochendorfer. E. A. LeFever of the Buffalo General Electric Company urged the formulation of test codes for meter departments to facilitate and render more uniform the work of this division. The difficulties and essential desirability of adequate supervision of meter testing as applied to outside men were stated by A. J. Allen of the United Electric Light & Power Company. The ensuing discussion developed diverging thoughts and practices in connection with the supervisory methods of several companies.

The stroboscopic method of meter testing was presented by W. H. Sparkes of the Westinghouse Electric & Manufacturing Company. This plan, not yet introduced commercially, involves a tremendous increase in the speed of testing watt-hour meters. Light and full-load calibrations may be completed in fifteen seconds. Calculated accuracy obtainable is 0.026 per cent. Actual present accuracy is well within 0.1 in the hands of inexperienced testers. The maintenance of demand meters was discussed by A. F. Gosselin, Rochester Gas & Electric Corporation. The design of totalizing meters and instruments was explained by H. K. Nock of the General Electric Company. D. P. Burleigh, General Electric Company; M. A, Zeek, Westinghouse Electric & Manufacturing Company, and H. Nehls, Landis & Gyr, also addressed the meeting. A paper was read by F. S. Burden of the Sangamo Electric Company.

Mr. Consler was re-elected chairman and G. B. Teevan of the Brooklyn Edison Company vice-chairman. Inspection trips to the Syracuse Lighting Company's meter department laboratory and substations were made.

Briefer News

HELENA (ARK.) PLANT TO DOUBLE CAPACITY.—The capacity of the Arkansas Utilities Company's 4,270-kva. generating plant at Helena is to be doubled by the installation of a new unit, according to R. M. Foster, Jr., local manager. The work is scheduled for completion by Jan. 1.

PENNSYLVANIA CONTRACTORS ELECT OFFICERS.—More than three hundred delegates met at Erie last week for the fifteenth annual convention of the Pennsylvania State Association of Electrical Dealers and Contractors. President W. V. Pangborne of Philadelphia, who gave the keynote address, was re-elected; W. S. Hurley of Erie was named vice-president, and M. G. Sellers of Philadelphia was re-elected as secretary-treasurer. The next convention will be held at Pittsburgh.

SOUTHERN CITIES POWER COMPANY TO BUILD ANOTHER HYDRO PLANT.—The Southern Cities Power Company will soon begin the construction of another hydro-electric plant at Lillard's Mill, Tenn. According to Clarence Watson, general superintendent of the company, the Lillard's Mill plant will be an exact duplicate of the Columbia plant, including two 500-kva. generating units and a transformer substation to step up the voltage from 3,300 to 44,000.

NEW HYDRO PLANT PROJECTED ON DES MOINES RIVER.—The Central States Electric Company of Cedar Rapids, Iowa, has plans for the erection of a million-dollar hydro-electric plant on the Des Moines River 12 miles south of Fort Dodge. The dam is to be of concrete with a permanent crest 20 ft. above the regular water level. Such a dam would back water up the river for 10 miles. If the state commission approves the project, construction may begin this year.

CONTENTION STILL PREVAILS OVER SERVICE AT MAPLETON, IOWA.—A long-drawn-out fight between the town of Mapleton, Iowa, and the Iowa Public Service Company led to a recent district court decree that the company's franchise was illegal and that it must quit business by Sept. 22. The company then applied for a stay order to the Supreme Court, which stipulated that the company must submit its appeal evidence not later than Oct. 18. This is taken to mean that the Supreme Court will either affirm or reverse the ouster decision this year. Mapleton installed a municipal lighting plant eighteen months ago. The fight against the company was started in 1922.

THIRD UNIT GOES IN AT FARMERS RAPIDS.—The initial installations at the power plants of the Gatineau Power Company on the Gatineau River, at Chelsea and Farmers Rapids, are now complete and a total of 174,000 hp. is available from the two plants. The third unit of 24,000 hp. at Farmers Rapids, marking the last of the initial installation, was started on Sept. 3 for the purpose of tuning up. At Chelsea three units of 34,000 hp. each are now in operation, and the combined operations at Chelsea and Farmers Rapids may be said to mark a great step in the final completion of the huge Gatineau River development by the subsidiary of the International Paper Company.

COMING HYDRO PLANT ON ETOWAH RIVER IN GEORGIA.—Many farms have been purchased by the Georgia Power Company preparatory to constructing a dam and hydro-electric plant at Cooper's Iron Works on the Etowah River, near Acworth, Ga. Bottom lands will, it is said, be inundated for many miles along the Etowah River, Altoona Creek and their tributaries. The size of the development contemplated has not yet been made public by the power company.

PROGRESS ON OCKLOCKNEE RIVER PLANT IN FLORIDA.—The 16,000-hp. hydro-electric plant of the West Florida Power Company on the Ocklocknee River in Florida, about 26 miles west of Tallahassee, is well under way, according to the General Engineering & Management Corporation. It involves a concrete dam and spillway 36 ft. high across the river, from the northern end of which will stretch an earthen dike one mile long. The power house itself will be of concrete and brick construction and will house two vertical generators. High-tension lines will run to various points on the transmission system which the Florida Power Corporation has built up during the past few years. The reservoir for this project will cover an area of approximately 13,000 acres, the head of the lake being about 15 miles above the crest of the dam.

MOVING TO BRING COLORADO RIVER WATER TO SOUTH CALIFORNIA.—The city of Pasadena, Cal., has been chosen to initiate an ordinance for the organization of the Metropolitan Water District to build the Colorado River Aqueduct. This action, which has an obvious bearing on the Colorado River problem, was taken at a meeting of the executive committee of the Colorado River Aqueduct Association held Sept. 10 in Los Angeles. It is planned to bring a friendly test case to determine the constitutionality of the Metropolitan Water District act passed by the last California State Legislature. President Hiram W. Wadsworth of the association is urging that as many cities as possible join in the movement for the aqueduct.

DISSATISFACTION WITH NEW ELECTRIC RATES IN INDIANAPOLIS.—When the two former Indianapolis companies were merged a few months ago into the Indianapolis Power & Light Company, announcement was made that the maximum domestic rate would be reduced from 7½ cents to 6½ cents a kilowatt-hour. This reduction has gone into effect, but dissatisfaction is expressed because the former discount of 10 per cent for prompt payment has been discontinued and a penalty of 10 per cent added to bills under the new schedule after 30 days. This, it is figured, makes the net reduction per kilowatt-hour only 3.6 per cent on the former net rate, instead of the 13⅓ per cent anticipated, and if the penalty be added, it dwindles still further.

KANSAS SECTION WILL MEET AT SALINA NEXT MONTH.—Oct. 20 and 21 have been selected as the dates for the thirtieth annual convention of the Kansas Section, N.E.L.A., with Salina as the meeting place. The Lamer Hotel will be used as convention headquarters, and sessions will be held on the assembly floor of the Salina City Hall. Paul S. Clapp, managing director N.E.L.A., will be one of several well-known speakers, and commercial topics, farm electrification, utility policies and women's work in the industry will occupy places of importance in the program. Dr. Howard T. Hill, head of

Coming Meetings

[A complete directory of electrical associations, with their secretaries, is published in the first issue of each volume. For latest list see the ELECTRICAL WORLD for July 2, page 50.]

Association of Edison Illuminating Companies—Colorado Springs, Col., Sept. 26-30. P. S. Millar, 80th St. and East End Ave., New York.

International Association of Electrical Inspectors, Western Section—Toronto, Canada, Sept. 27-29. W. S. Boyd, 175 W. Jackson Blvd., Chicago.

American Electric Railway Association—Cleveland, Oct. 3-7. J. W. Welsh, 292 Madison Ave., New York.

Empire State Gas and Electric Association—Lake Placid Club, Lake Placid, N. Y., Oct. 6 and 7. C. H. B. Chapin, Grand Central Terminal, New York.

Illuminating Engineering Society—Edgewater Beach Hotel, Chicago, Oct. 11-14. L. H. Graves, 29 West 39th St., New York City.

Eastern Association of Electrical Inspectors—Springfield, Mass., Oct. 12-13. E. P. Slack, 85 John St., New York.

Southern Appalachian Power Conference—Chattanooga, Tenn., Oct. 13-15.

Rocky Mountain Division, N.E.L.A.—Broadmoor Hotel, Colorado Springs, Col., Oct. 17-20. O. A. Weller, 900 15th St., Denver.

National Association of Railroad and Utilities Commissioners—Dallas, Tex., Oct. 18-21. James B. Walker, 270 Madison Ave., New York.

Kansas Section, N.E.L.A.—Lamner Hotel, Salina, Kan., Oct. 20-21. H. L. Jones, 401 National Reserve Bldg., Topeka.

National Electrical Manufacturers' Association—Apparatus Division, Briarcliff, N. Y., Oct. 24-27; Radio Division, Edgewater Beach Hotel, Chicago, Nov. 28-Dec. 1. S. N. Clarkson, 420 Lexington Ave., New York.

Public Utilities Association of West Virginia—Parkersburg, W. Va., Oct. 26-27. A. B. McCrum, 514 Charleston National Bank Bldg., Charleston.

Electrical Supply Jobbers' Association—Book-Cadillac Hotel, Detroit, Nov. 14-18. F. Overbagh, 411 S. Clinton St., Chicago.

the department of public speaking, Kansas State Agricultural College, Manhattan, will be the principal speaker at the dinner.

CHICAGOANS HEAR ABOUT TRANSFORMER RATIO CONTROL.—At the first meeting of the season of the Chicago Section, A.I.E.E., L. F. Blume of the transformer engineering department of the General Electric Company addressed a large audience on "Ratio Control of Transformers Under Load" and held its interest despite the 90 deg. F. which prevailed. The speaker described the principles of operation on which ratio control is based and compared the electrical characteristics of the various methods by which the general idea is put into practice. The functions of ratio-control devices in electrical systems and a comparison of them with other methods of voltage control were features of the talk, which was illustrated with lantern slides.

CHIPPEWA FALLS HYDRO-ELECTRIC DEVELOPMENT.—Construction work on the development of hydro-electric power for the Northern States Power Company at Chippewa Falls on the Chippewa River has been started in accordance with preliminary plans announced late in 1926. The Chippewa Falls plant, operating under a head of 30 ft., will have a capacity of 30,000 hp. in six units of 5,000 hp. each, which is somewhat larger than the original rating previously published. The dam and power house will be in Chippewa Falls about 3 miles below the hydro-electric development at Wissota, which has a capacity of 42,000 hp. It will utilize water storage created by the Wissota dam and will be tied in with the transmission system of the Northern States Power Company in Wisconsin and Minnesota. A feature of the development will be the use of waterwheels with adjustable blades, which will enable the plant to operate at maximum efficiencies as the load or demand varies.

SAN FRANCISCO SUPERVISORS VOTE FOR POWER LINE.—A bond issue of $1,800,000 to build a power line between Newark, the present terminus of the Hetch Hetchy power line from the Moccasin Creek plant, and San Francisco was authorized by the Board of Supervisors at a recent meeting after a long and heated controversy. It was finally carried by a vote of sixteen to one. Supervisor Jesse M. Colman, voting "no," said: "To build a power line into the city without provisions for a distributing system is merely an idle gesture and means nothing." Supervisor Havenner, who moved the resolution, said: "This will let the power companies know that the city means business on this power matter. It puts the city in position to go ahead, if necessary, on building its own distributing system. If the power companies refuse to accept the present valuation proceedings, the city will then be in a position to act."

Commission Rulings

DEFINITION OF "RURAL CUSTOMER."—In making rules to govern the extension of service by the Evansville (Wis.) Water & Light Commission to rural communities and fixing a minimum service charge of $3 and a maximum of $7, both plus an energy charge of 7½ cents a kilowatt-hour for the first 50 kw.-hr. in a month and 3½ cents for any excess, the Wisconsin Railroad Commission defined a "rural customer" as "a purchaser of electric service (except customers of a class for which the utility has a suitable urban rate filed with the Railroad Commission) who can be adequately served from one transformer of not more than 10 kva. capacity and who uses the service in the conduct of one enterprise, occupation or institution, located outside the limits of the city of Evansville or community with similar characteristics, at such distance that it cannot be adequately served from the secondary lines of the local distribution system."

COMPLAINT DISMISSED WHEN COMPANY SHOWS DESIRE TO IMPROVE SERVICE.—A complaint of inferior service brought against the Tunkhannock Electric Company was dismissed by the Public Service Commission of Pennsylvania when the company, as the result of an engineering conference, voluntarily repaired and put in service its voltage regulators and reconstructed parts of its distribution system. The commission, however, decreed that the company "should in the future maintain its voltage regulators in proper operating condition, attempt through co-operative effort to eliminate any tangled and hazardous conditions found to exist between the power circuits and the circuits of the local telephone company, and continue the program for reconstruction of those older parts until the distribution system in its entirety shall have been brought into conformity with the accepted operating standards."

HIGH AND LOW DEMAND CHARGE NOT DISCRIMINATORY.—A complaint of discrimination made against the Northern Pennsylvania Power Company and based on the premise that a consumer of a lesser amount of kilowatt-hours with a high demand pays a greater amount on the average per kilowatt-hour than does a consumer with a lower demand and a greater consumption has been dismissed by the Pennsylvania Public Service Commission on the ground that the circumstances and conditions of service with respect to the two consumers are not similar and that unlawful discrimination does not result. It appeared that the company had in effect a two-part rate consisting of a demand charge of $1 per customer plus the energy rate of 10 cents per kilowatt-hour for the first 100 kw.-hr., 9 cents for the next 200 kw.-hr., and 5 cents thereafter. This schedule was to remain in effect, but an optional schedule was offered under which there would be a demand charge of $1.10 per month for the first six demand units or less, which was to be increased 10 cents per month for each additional unit to and including 21 units, and 5 cents per month for each unit in excess of 21 units. An additional demand charge of $1 per horsepower or fraction thereof was made for all power equipment in excess of 1 hp. in the connected load. The energy charge in addition to the demand charge was to be 6 cents per kilowatt-hour for the first 30 kw.-hr. used and at the rate of 5 cents thereafter.

Recent Court Decisions

COMPANY HELD LIABLE FOR DAMAGES CAUSED BY SPREAD OF FIRE SET BY IT.—The District Court of Appeal in California has found that the Los Angeles Gas & Electric Corporation was properly held liable in damages for the destruction of property caused, as alleged, by the spreading of a fire started by the company on a vacant lot to destroy rubbish and spreading to property of the plaintiff (Alechoff). The fire, it was testified, was not extinguished at 9 a.m., the time prescribed by city ordinance. (257 Pac. 569.)*

MARYLAND COMMISSION'S REFUSAL TO SANCTION SALE SUSTAINED.—The Circuit Court in Baltimore has handed down an opinion upholding the refusal of the Maryland Public Service Commission to grant the Electric Public Utilities Company of Chicago permission to purchase four small electric light and power plants in western Maryland. (See ELECTRICAL WORLD for July 23, page 182.) In refusing to substitute its judgment for the findings of the commission, the court said: "The sole issue is whether the order is unlawful or unreasonable. There are conditions about which judgments may differ, but on the record in this case it certainly cannot be said that the order is unreasonable, nor is it difficult to perceive how the public interest is involved. If the record, taken as a whole, shows the facts on which the order is founded, the law does not require that the order itself should embody the facts on which it is based. The power conferred on the commission is salutary for the adequate and complete protection of the public interest of the citizens of this state. It has had the acquiescence of the administrative authorities and the corporations affected for seventeen years and is not to be set aside unless it is clearly made to appear to be against some inhibition of the constitution."

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

News About Men of the Industry

J. W. Perry Retires

James W. Perry, who has retired as a vice-president and director of the Johns-Manville Corporation, New York, and from all active business connections, as announced in the Sept. 17 issue of the ELECTRICAL WORLD, will leave shortly for California owing to the illness of his wife. For twenty-five years Mr. Perry has been a leader in the electrical industry and an influence for progress and good business practice. His retirement, therefore, removes from the ranks a figure long conspicuous in manufacturing circles.

Mr. Perry's early experience was with the Rex Hardware Company, agent for

J. W. PERRY

the H. W. Johns Manufacturing Company in Parkersburg, W. Va. He continued in this employ for approximately three years, but resigned to take a sales position with the H. W. Johns Manufacturing Company's Philadelphia office. In 1902, when the H. W. Johns Manufacturing Company of New York and the Manville Covering Company of Milwaukee consolidated, he removed to New York in charge of the electrical business of the new company. He became general manager of the electrical, automotive and public utilities departments and three years ago was elected a vice-president.

In spite of the heavy responsibilities of his executive position with the Johns-Manville Company, Mr. Perry has given unstintingly of his time and energy to association work. He was instrumental in establishing the first organized movement among the manufacturers of electrical materials, which resulted in the formation of the Associated Manufacturers of Electrical Supplies, and he served as the treasurer and a member of the board of this association from its inception until September, 1922. After the organization of the National Electrical Manufacturers' Association he continued his association work as chairman of the committee on the promotion of codes, ordinances and statutes and of the Underwriters' Laboratories committee. For many years he has been active in the work of the National Electric Light Association, in addition to being a member of the American Institute of Electrical Engineers, the American Electric Railway Association and the Society of Automotive Engineers. Mr. Perry is also a member of the New York Electrical Society, the Engineers' Club, the Engineers' Country Club, Westchester Biltmore Country Club, Sea View Country Club, Lyers Club and the New York Athletic Club.

J. M. Oliver Made Operating Manager of Georgia Utility

J. M. Oliver, formerly operating engineer of the Alabama Power Company, has been appointed operating manager of the Georgia Power Company, assuming the duties heretofore performed by C. E. Bennett. Mr. Oliver is a native of Alabama and a graduate of the Alabama Polytechnic Institute. He entered the employ of the Alabama Power Company in 1915 and served in almost every department of that company before becoming operating engineer.

C. E. Calder Vice-President of Electric Bond & Share

C. E. Calder, president of the American & Foreign Power Company, Inc., and formerly president of the Texas Power & Light Company, has been elected a vice-president of the Electric Bond & Share Company, New York. Mr. Calder became identified with the Electric Bond & Share organization in 1913, when he was appointed secretary of the Texas Power & Light Company and affiliated companies, with headquarters at Dallas, Tex. Previously he had had some sixteen years of varied experience in public utility operations.

HUGH WHITE, commerce counsel for the Alabama Public Service Commission, was appointed president of the commission Sept. 15 by Governor Bibb Graves. This appointment fills the vacancy created by the resignation of A. G. Patterson, who retired from the commission to accept the appointment as probate judge of Morgan County as reported in the Sept. 10 issue of the ELECTRICAL WORLD.

H. H. GANSER, whose election to the general managership of the Philadelphia Suburban Counties Gas & Electric Company, was announced in the Sept. 17 issue of the ELECTRICAL WORLD, is in addition vice-president of the company in charge of the Schuylkill division, an office he held prior to the merger of the Philadelphia Suburban Gas & Electric Company with the Counties Gas & Electric Company.

T. Slade to Direct Sales Work in Detroit

Theodore Slade has been appointed director of utility sales for Kelvinator, Incorporated, at Detroit following a year's work in the utility division of that company. Mr. Slade has had fifteen years' experience in utility work, having been assistant manager at Wichita, Kan., for the Henry L. Doherty & Company gas interests in that section and Wichita district manager for the Kansas Gas & Electric Company for two and a half years in charge of both the electric and gas operations at that point. Prior to 1922 Mr. Slade spent four and a half years as district manager for

THEODORE SLADE

the same company at Eldorado, Kan. where he acquired a taste for the merchandising end of the utility business while engaged in extensive oil-field electrification work.

Mr. Slade is a graduate of the College of Engineering, State University of Kentucky, class of 1911, and has been engaged in utility work since that time. His present work is that of directing negotiations and sales work, as well as interpreting utility policies for his company in the rapidly growing list of utilities handling Kelvinator products.

Obituary

WARREN F. HUBLEY, president and general manager of the American Transformer Company, Newark, N. J., died suddenly at his home in East Orange Sept. 19. Mr. Hubley was 47 years of age.

JOSEPH C. HAMILTON, vice-president of the California Association of Electrical Inspectors and for the past four and one-half years city electrician of San Jose, Cal., died in that city Aug. 12, following an operation. He was a native of Utah.

Financial and Statistical News

General Market Irregular Utility Stocks Firm Money Rates at 4 Per Cent

FOLLOWING the severe break which occurred in the last few minutes of Saturday's trading, the market early this week was in a somewhat demoralized condition and declines were scored by many of the leading stocks. Several recoveries were reported on Tuesday, but the day closed with irregular net changes. In spite of this general setback the electric light and power securities held firm and several substantial gains were made during the week under review. American Gas & Electric advanced from 107½ to 117 and American Light & Traction from 179½ to 183½. Gains were also reported for the Pacific Gas & Electric Company, the North American Company and the Public Service Corporation of New Jersey. The reverse side of the market showed slight losses for Consolidated Gas, Electric Light & Power of Baltimore, Detroit Edison and the Edison Electric Illuminating Company of Boston. The index of common stocks compiled by the ELECTRICAL WORLD covering electric light and power securities showed an increase of two points over the preceding week. The preferred stock index figure advanced from 93.7 to 94.0 and the bond index figure from 103.6 to 104.0.

It is quite evident that the earnings and growth records of the utilities are winning for their securities a constantly widening legal and investment market. This new demand from investment trusts, savings banks and insurance companies, together with easy money rates, appears to be sufficient to maintain present prices, if not to increase the upward trend.

Call money advanced to 4 per cent. On the whole money is half to three-quarters of 1 per cent under the prevailing rates of a year ago.

HARTFORD ELECTRIC INCREASES CAPITAL.—Stockholders of the Hartford Electric Light Company at a meeting held Sept. 7 approved the legislative amendment to the company's charter permitting an increase in the authorized capital stock from $20,000,000 to $30,000,000, par $100.

Company Reports

Name of Company	Gross Earnings Twelve Months Ended July 31 1927	1926
Adirondack Power & Light*...	$9,620,999	$8,956,082
Arizona Power†.....	456,587	490,953
Columbus Electric & Power...	4,013,110	3,358,774
Duquesne Light.....	25,113,375	23,536,542
Eastern Texas Electric.....	6,681,356	5,010,403
National Power & Light.....	35,653,107	32,033,055
Utah Power & Light.....	10,620,603	10,256,969

* Twelve months ended Aug. 31.
† Eight months ended July 31.

Electric Power Business Still Gains

July Energy Output and Revenue Increased 8 Per Cent—Water Power Nearly 40 Per Cent of the Total Improved Efficiency in Use of Fuel

AN 8 PER CENT increase in energy output and a substantially equal increase in revenue over the corresponding month's operations in 1926 are indicated for the electric light and power industry for July, according to statistics collected by the ELECTRICAL WORLD. In both respects the gain is somewhat less than it was in June.

The energy generated amounted to 6,102,589,000 kw.-hr. and the revenue to $134,000,000, the corresponding daily averages being 197,000,000 kw.-hr. and $4,320,000. In accordance with the usual seasonal change, these figures are lower than those for June. However, the daily energy output is 10,000,000 kw.-hr. above the normal based on the past five years' growth; the daily revenue is still somewhat below the normal thus determined—$4,430,000—but with the exception of June that condition has prevailed for many months. The normal is based on a period that began with moderate business activity and ended with two remarkably high years, and thus probably represents a somewhat exaggerated rate of growth, which cannot continue indefinitely. Operating expenses, $62,700,000, also show an 8 per cent rise. The daily average is $2,020,000, a figure that, with the exception of one month, has scarcely varied since January.

TABLE I—GENERATION AND DISTRIBUTION OF CENTRAL-STATION ENERGY IN THE UNITED STATES
(100 Per Cent of the Industry)

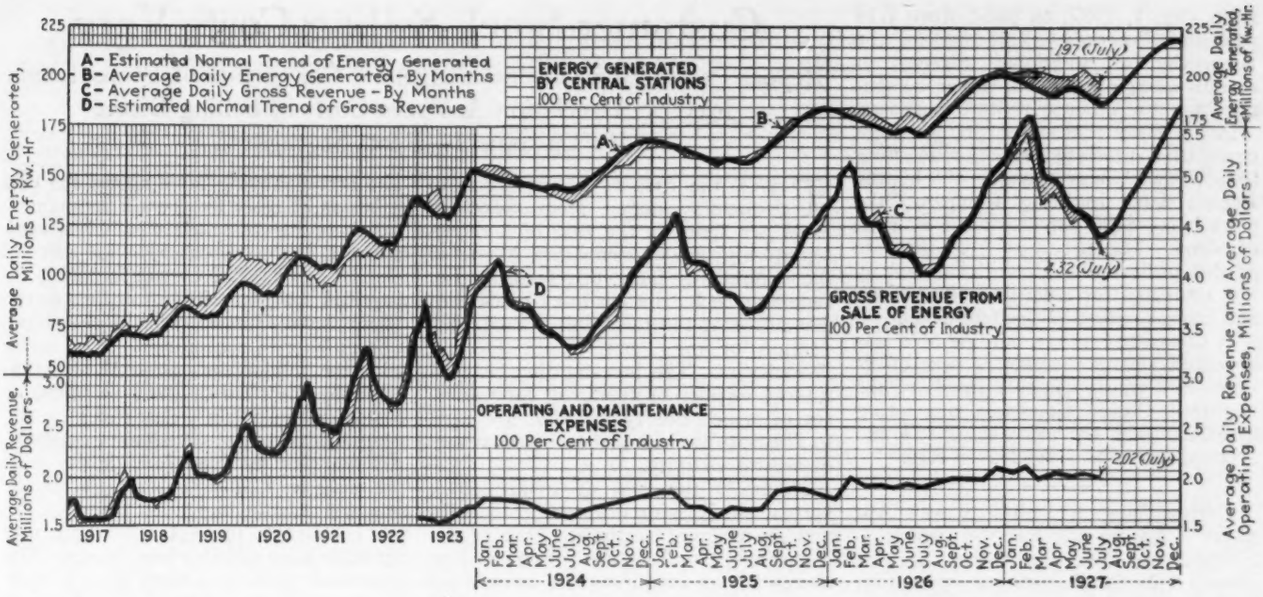
Month	Kw.-Hr. Generated Monthly *			Estimated Distribution of Energy Generated										Energy Purchased by Public Utilities for Resale, Kw.-Hr.	
				Total Energy Consumption by Central-Station Customers, Kw.-Hr.		Energy Consumed for Lighting, Kw.-Hr.		Energy Consumed for Power, Kw.-Hr.		Energy Sold to Electric Railways, Kw.-Hr.		Energy Used in Intracompany Business, Including Line Losses, Kw.-Hr.			
	1927 Thousands	1926 Thousands	Per Cent Inc.	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands
April..	6,049,656	5,389,573	+12.3	4,979,656	4,349,573	1,235,000	1,152,000	3,194,656	2,655,573	550,000	542,000	1,070,000	1,040,000	1,189,000	1,007,000
May..	6,218,471	5,436,704	+14.4	5,123,471	4,386,704	1,252,000	1,164,000	3,329,471	2,688,704	542,000	534,000	1,095,000	1,050,000	1,252,000	1,009,000
June..	6,127,279	5,509,356	+ 9.0	5,047,279	4,446,365	1,205,000	1,150,000	3,314,279	2,774,356	528,000	522,000	1,080,000	1,063,000	1,223,000	1,050,000
July...	6,102,589	5,562,172	+ 8.0	5,022,589	4,492,172	1,242,000	1,164,000	3,256,589	2,811,172	524,000	517,000	1,080,000	1,070,000	1,202,000	1,033,000

*Data on "energy generated" are those collected and published by the United States Geological Survey for all public utilities minus such data as are collected on energy generated by electric railway companies, reclamation service and manufacturing plants. The data are, therefore, for the electric light and power industry only.

TABLE II—CENTRAL-STATION FINANCIAL OPERATIONS FOR FOUR MONTHS IN THE UNITED STATES
(100 Per Cent of the Industry)

Month	Total Gross Revenue from Sale of Energy†			Estimated Distribution of Gross Revenue								Total Operating and Maintenance Expenses‡	
				Lighting Customers		Power Customers		Electric Railways		Other Public Utilities			
	1927 Thousands	1926 Thousands	Per Cent Inc.	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands
April....	$145,700	$132,500	+10.0	$86,700	$80,600	$43,400	$37,400	$5,100	$4,830	$10,500	$9,670	$62,100	$54,900
May.....	140,600	126,900	+10.8	83,100	77,900	42,300	35,400	4,800	4,700	10,400	8,900	62,280	57,530
June....	138,700	125,600	+10.4	81,500	77,200	42,000	35,100	4,700	4,600	10,500	8,700	62,400	57,700
July.....	134,000	123,900	+ 8.1	78,400	74,900	41,900	35,700	4,400	4,400	10,300	8,900	62,700	58,100

†Aggregate gross revenue from actual consumers, and sales to other public utilities for resale, involving a certain amount of duplication.
‡Do not include interest, taxes, depreciation or sinking fund.


A- Estimated Normal Trend of Energy Generated
B- Average Daily Energy Generated - By Months
C- Average Daily Gross Revenue - By Months
D- Estimated Normal Trend of Gross Revenue
ENERGY GENERATED BY CENTRAL STATIONS
100 Per Cent of Industry
GROSS REVENUE FROM SALE OF ENERGY
100 Per Cent of Industry
OPERATING AND MAINTENANCE EXPENSES
100 Per Cent of Industry
197 (July)
4.32 (July)
2.02 (July)
Average Daily Energy Generated, Millions of Kw.-Hr.
Average Daily Revenue, Millions of Dollars
Average Daily Revenue and Average Daily Operating Expenses, Millions of Dollars
Average Daily Energy Generated, Millions of Kw.-Hr.
1917 1918 1919 1920 1921 1922 1923
1924 1925 1926 1927

Notwithstanding a moderate seasonal increase, the large and steady output of hydro plants is again in evidence; more than 2,400,000,000 kw.-hr., or nearly 40 per cent of the total energy generated, was hydro-electric. For a midsummer month this is unusually high; it exceeds the hydro output of July, 1926, by 430,000,000 kw.-hr. The 110,000,000-kw.-hr. increase in output from fuels was achieved with a reduction of coal consumption—the preliminary figure shows 5,000 tons less—a smaller consumption of fuel oil than in any month since 1919, the beginning of available records on the subject, and only a small increase in the use of natural gas.

Regionally the relative increase in energy output was greatest in the West South Central States and least in the West North Central. New England for the first time in many months exceeded the national average. Otherwise the northern part of the country from the Atlantic across to the Rockies, with local exceptions, shows smaller gains, while practically the entire South reports notable advances. The years' increase in revenue shows similar tendencies, the Southern States leading, followed by New England, while in the North Central States and on the Pacific Coast the gains were more moderate.

The influence of interconnections is again revealed in the intercompany sales of energy, which have been about 17 per cent higher than last year for each month since April. This is a rapid development, but the pace appears to be slackening; there was a time when the year's increase exceeded 30 per cent. Although it is impossible to determine to what extent, if any, the statistics on this item may involve duplication in the sense that the same energy is resold a second time, if any exists it is not believed to be serious. On the face of the returns it appears that about 20 per cent of the energy generated is sold at wholesale to other power companies.

Operating ratios show a slight decrease from July, 1926, except in the case of pure hydro systems. The latter, as reported, generate less than a fourth of the total hydro-electric energy output, since most waterpower systems are interlinked with steam plants. Consequently the operating ratio of the group may be appreciably affected by abnormal conditions or missing reports for a single large system. In computing the ratio one municipal hydro system has been excluded because its operations are not typical, and their inclusion would be misleading.

TABLE III—OPERATING RATIO OF CENTRAL-STATION COMPANIES

	Operating Ratio					
	Steam Plants		Hydro Plants		Combined Hydro and Steam Plants	
	1927	1926	1927	1926	1927	1926
April	44.8	44.7	35.5	33.7	39.5	39.9
May	47.9	48.4	37.9	35.3	42.2	43.4
June	48.9	49.9	35.3	32.1	42.5	45.0
July	51.3	52.3	34.2	33.4	44.3	46.4

New Capital Issues

Following authorization by the Railroad Commission of the State of California, the Pacific Gas & Electric Company issued first and refunding mortgage 4½ per cent bonds, series E, a piece of financing involving a total of $15,000,000. These securities, due June 1, 1957, were priced at 96 and interest, to yield 4.75 per cent. Proceeds of the loan will be used to refund the company's own securities and those of its subsidiaries.

First mortgage and refunding 20-year 5 per cent gold bonds, series B, of the Jersey Central Power & Light Company were offered during the week under review to the amount of $2,300,000, the price being 96½ and interest, to yield over 5.25 per cent. These bonds were offered with the purpose of raising funds to reimburse the company in part for expenditures made or to be made in connection with improvements, extensions and additions to the plants and properties of the company.

The American Superpower Corporation issued 25,000 additional shares of first preferred stock, the price being $98.50 per share and accrued dividend

TABLE IV—OPERATIONS OF CENTRAL-STATION HYDRO AND FUEL PLANTS IN THE UNITED STATES*
(100 Per Cent of the Industry)

Month	Energy Generated						Fuel Consumption								
	Hydro-Plants			Fuel Power Plants			Coal			Oil			Gas		
	1927 Thousands of -Hr.	1926 Thousands of Kw.-Hr.	Per Cent Increase	1927 Thousands of Kw.-Hr.	1926 Thousands of Kw.-Hr.	Per Cent Increase	1927 Short Tons	1926 Short Tons	Per Cent Increase	1927 Barrels	1926 Barrels	Per Cent Increase	1927 Thousands of Cubic Feet	1926 Thousands of Cubic Feet	Per Cent Increase
April	2,526,938	2,279,976	+10.8	3,522,718	3,109,597	+13.3	2,942,421	2,742,058	+7.3	524,148	600,368	—12.7	4,482,900	3,465,746	+29.2
May	2,625,427	2,266,305	+15.9	3 593 044	3,170,399	+13.3	2,918,935	2,720,082	+7.3	462,386	569,125	—18.8	4,825,262	3,712,226	+30.0
June	2,492,336	2,191,225	+13.7	3,634,943	3,318,131	+ 9.6	2,902,310	2,807,988	+3.4	450,732	589,567	—23.6	5,219,243	4,190,576	+24.5
July	2,401,841	1,971,199	+21.8	3,700,748	3,590,973	+ 3.0	2,988,389	2,993,969	— .2	447,494	671,984	—33.4	5,520,363	5,056,094	+ 9.2

*As collected by United States Geological Survey. The data are for the electric light and power industry only.

from Oct. 1, 1927, to yield about 6.10 per cent. Proceeds will be used for the acquisition of additional interests in certain electric light and power companies and for other corporate purposes.

An additional issue of 6 per cent cumulative preferred stock, amounting to $1,000,000, was brought out by the Long Island Lighting Company, the price being $100 per share and accrued dividend. The proceeds from the sale of this preferred stock will be used by the company for additions, extensions and improvements to the properties.

A Canadian issue of considerable size appeared among the week's new offerings—first mortgage gold bonds of the Gatineau Power Company, amounting to $18,500,000, the price being 97½ and accrued interest to yield over 5.16.

CITIES SERVICE STOCKHOLDERS APPROVE CHANGE IN PAR OF STOCK.—Stockholders of the Cities Service Power & Light Company at a meeting held Sept. 7 approved the proposal referred to in the Aug. 13 issue of the ELECTRICAL WORLD to change the authorized preferred stock from $100 par to no-par-value shares.

Customer Stock-Selling Costs Vary

Report Presented at Twentieth Annual Convention of Pennsylvania Electric Association Analyzes Costs of Selling Direct to Customers—Items Segregated

THAT the cost of selling stock to customers ranged from $2.66 to $8.94 per share in the case of a representative group of companies is one of the interesting facts disclosed by the report made by the customer-ownership committee at the twentieth annual convention of the Pennsylvania Electric Association. The investigation covered a large number of operating companies, six of which are typical and are used to illustrate various phases of customer-ownership activity.

Naturally the cost of selling stock varies widely with different companies and in different sections. One of the companies studied has been selling shares to its customers for more than seven years. In 1926 this company sold one-third of the total number of shares outstanding in the territory served. This shows the effect of repeat orders and that a saturation point is only temporary. The accompanying table shows the distribution of costs for the six companies.

Rehandling of stock which has been returned is also discussed, with costs in specific cases. The cost of handling reacquired shares varies, according to the report, from 37 cents to $2.11 per share. The number of reacquired shares varies with the amount of personal attention given by the head of the investment or customer-ownership department, the general manager or divisional managers. An interview by those in authority with the customers offering their shares for sale and a little ingenious planning for the customer's interest will frequently persuade them to hold their shares. The committee finds it is more than a coincidence that a majority of the cities and towns which have a saturation below the average have a relatively high average "dollars of stock per holder." "Further," it reports, "we know of no

Stock Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday Sept. 20	Low 1927	High 1927
ABITIBI PWR. & PAPER, 4% com.—no par	109	83	109½
Adirondack Pwr. & Lt.—7% pf.	112	107	113½
Adirondack Pwr. & Lt.—8% pf.	115	112	116
Ala. Pwr., $7 cum. pf.—no par	111½	107½	114
Allis-Chalmers Mfg., 7% pf.	m111½	109	112½
Allis-Chalmers Mfg., 6% com.	115	88	115½
Aluminum Co. of Amer., com.	100	67½	105½
Aluminum Co. of Amer., 6% of	103	101½	104½
Amer. & Foreign Pwr., pf. 25% pd.	m110	....	....
Amer. & Foreign Pwr., 7% pf.—no par	105½	86½	108
Amer. & Foreign Pwr., com.—no par	26½	18½	26½
Amer. Bosch Magneto, com.—no par	25½	13	26½
Amer. Brown Boveri Elec†	9½	5½	39½
Amer. Brown Boveri Elec., pf. $7	45½	40	98
Amer. Gas & Elec., 6% pf.—no par	104½	95½	105½
Amer. Gas & Elec., com.†—no par	117	68½	117½
Amer. Lt. & Trac., 6% pf.	115	112	120
Amer. Lt. & Trac., new com.	183½	164½	186
Amer. Pwr. & Lt., 6% pf.	105½	97½	106½
Amer. Pwr. & Lt., com.†—no par	66½	54	67½
Amer. Pub. Serv., 7% pf.	a100½	94	104
Amer. Pub. Serv., com.†	70	....	....
Amer. Pub. Utilities, 7% ptc. pf	a 87½	73	88½
Amer. Pub. Utilities, 7% pr. pf.	a 93½	92	96
Amer. Pub. Utilities, com.	k 53	65	70
Amer. States Sec., A	4½	2½	4½
Amer. States Sec., B	4½	2½	4½
Amer. Superpwr., 6% ptc pf.—25	29	26½	29½
Amer. Superpwr., 6% 1st pf.	f 98½	....	....
Amer. Superpwr., Class A†—no par	39½	27½	39½
Amer. Superpwr., Class B†—no par	40½	28½	40½
Amer. Wtr. Wks. & Elec., 7% pf.	m111½	104½	111½
Amer. W. W. & E., com. new—no par	62½	46	62½
Anaconda Copper cap. $3	49½	41½	49½
Appalachian Electric Pwr., 7% pf.	102½	100	105
Appalachian Elec. Pwr., com.	m 78	77	83
Arizona Pwr., 7% pf.	k 75	77	84½
Arizona Pwr., com.	m 20	....	....
Arkansas Pwr., & Lt. 7% pf.	104	....	....
Assoc. Gas & Elec., $3.50—50	50½	....	....
Assoc. Gas & Elec., pf.—$6—no par	93	85	93
Assoc. G. & E., Class A, 10—no par	42½	35	43½
BABCOCK & WILCOX, 7% com.	113	115	123
Binghamton L., H. & P., $6 pf.	98	93	100
Birmingham Elec., pf.—$7—no par	107	105	109
Blackstone Valley G. & E., 6% pf.	106	103	105
Blackstone Valley Gas & Elec., 10% com.—50	142	98	154½
Blaw-K nox, com.†	f 92	70	95
Brazilian Trac., Lt. & pwr., com.†	f192½	....	....
Broad River Pwr., 7% pf.	103	97	103
Brooklyn Edison, 8% com.	180	148½	184½
Buffalo, Niagara & East. Pwr., $1.60 pf.—25	f 26	....	....
Buffalo, Niagara & East. Pwr. com. $1—no par	f 37½	....	....
CALIFORNIA ELEC. GENERATING, 6% pf.	97	96	99½
California Ry. & Pwr., 7% pf.	135	125	150
Carolina Pwr. & Lt., pf.—$7—no par	f109	107	109
Central & S.W. Util., $7 pf.—no par	a 96½	92½	97½
Central & S.W. Util., pr.in.$7 pf.—no par	a102½	98½	104½
Central Ariz. Lt. & Pwr., 8% pf.	k 97	95	98
Central Ark. Ry. & Lt., 7% pf.	106	100	104
Central Ill. Pub. Serv., $6 pf.	a 93	88½	95½
Central Ind. Pwr., 7% pf.	92	86	95
Central Pwr. & Lt., 7% pf.	103	100½	103
Central States Elec., 7% pf.	97	93	97
Central States Elec., com.†	m200	....	....
Century Elec., 6% com.	m115	115	115
Chicago Fuse Mfg., com.—$2.50 no par	m 35½	30	35½
Cincinnati Gas & Elec., 5% com.	g 99½	96½	100½
Cities Service, $6 pf—no par	i 90½	87	92½
Cities Service, pf. B—no par	i 8½	8	8½
Cities Service, pf. BB—no par	i 82½	80½	85
Cities Service, com.—20	i 49	40½	58½
Cities Service, Bks. Shrs.—10	i 24½	22½	27
Clarion River Pwr., 8% pf.	95	....	....
Cleveland Elec. Illg., 6% pf.	110½	108	112
Cleveland Elec. Illg., 10% com.	322	285	330
Columbia Gas & Elec., 6% pf.	107½	99½	107½
Columbia G. & E. com. $5—no par	95½	82½	98½
Columbia Ry., Gas & Elec., 6% pf.	m 98	97	100
Columbus Elec. & Pwr., $2 com.—no par	69	....	....
Columbus Ry., Pwr. & Lt., 6%, 1st pf.	104	98½	104
Columbus Ry., Pwr. & Lt., 6½% pf. B	101½	96	103½
Columbus Ry., P. & L., com.—no par	100	75	105
Commonwealth Edison, 8% com.	a155½	138	155½
Commonwealth Pwr., 6% pf.	101½	91½	101½
Commonw'th Pwr., $2, com.—no par	62½	48½	62½
Conn. Lt. & Pwr., 8% pf.	121	119	123
Conn. Lt. & Pwr., 7% pf.	117	112	118
Cons. Gas of N. Y., pf.	100½	93	100½
Cons. Gas of N. Y., com $5—no par	121	94	121½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6% pf.	e110	106½	110½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6½% pf.	e113½	110½	114½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 7% pf.	k110	111	115
Cons. Gas, Elec. Lt. & Pwr. of Balti., 8% pf.	e127½	127	130½
Cons. Gas, Elec. Lt. & Pwr. of Balti., com. $2.50—no par	e 62½	51	63½
Consolidated Pwr. & Lt., 7% pf.	105	100	106
Consumers Pwr., 6% pf.	102½	100	102
Consumers Pwr., 6.6% pf.	104½	103	105½
Continental Gas & Elec., 8% ptc. pf.	108	103	106½
Continental Gas & Elec., 7% pr. pf.	103	100	103
Conti. G. & E. com. $4.40—no par	k250	210	225
Crocker Wheeler, com.†	25	30	38
Crocker Wheeler, 7% pf.	82	78	88
DALLAS PWR. & LT., 7% pf.	109	107	110½
Dayton Pwr. & Lt., 6% pf.	107	101	107
Detroit Edison, 8% com.	156½	133½	160½
Dubilier Condenser, com.—no par	4½	2½	5½
Duquesne Lt., 7% pf.	k115½	114½	116½
EASTERN NEW YORK UTIL., $7 pf.	107	102	104½
Eastern New York Util. com.	65	70	75
Eastern States Pwr., $7, com.	9	9	13
Eastern States Pwr., pf.	95	90	95
East. Tex. Elec., 7% pf.	106	106	108
Edison Elec. of Boston, $12 com.	d258	217	267
El Paso Elec., 7% pf.	109	105	107½
Elec. Bond & Share, 6% pf.	l109½	101½	109½
Elec. Bd. & Sh. Sec., com. $1—no par	f 75½	67½	79½
Electric Household Util.†	d 13½	11	15½
Elec. Investors, 6% pf.—no par	96	92	97
Elec. Investors, com.†—no par	42	32½	42½
Elec. Investors, 10% pd. receipts	m 15	....	....
Elec. Pwr. & Lt., ctfs. pf.	105½	96	106½
Elec. Pwr. & Lt., ctfs., 40% pd.	k116½	103½	116½
Elec. Pwr. & Lt., ctfs, full pd.	m114	108½	111½
Elec. Pwr. & Lt., ctfs., com.—no par	27	16½	28
Elec. Refrig. cap.†	13½	12½	37½
Elec. Ry. Securities, com.—no par	6½	....	....
Elec. St. Battery com. $5.25—no par	71½	63½	63½
Elmira Wtr., Lt. & R.R., 7% pf.	103	99	101½
Emerson Elec., pf.	m109	107½	111
Empire Pwr., ptc.†	35	....	....
Engr. Pub. Serv., $7 pf.—no par	m105	93½	106½
Engr. Pub. Serv., com.—no par	34½	21½	36
Eureka Vacuum Cleaner, com. $4—no par	70	50	77
FAIRBANKS MORSE, 7% pf.	k111	107½	112
F.-M., com.—$3—no par	37½	37	43½
Federal Lt. & Trac., com. $1.40	42½	37½	47
Federal Lt. & Trac., $6 pf.—no par	99	91½	100
Ft. Worth Pwr. & Lt., 7% pf.	f111	108	112
GALVESTON-HOUSTON ELEC. 6% pf.	70	68	72
Galveston-Houston Elec., com.	32½	26	32
Gen. Elec., $3 com.—no par	137	81	146½
Gen. Elec., special—6%	11½	11	11½
Gen. Gas & Elec. (Del.) com. A. $1.50—no par	k40½	34	47½
Gen. G. & E. (Del.) com. B—no par	m 45	35½	44½
Gen. G. & E. (Del.) pf. A. $8—no par	k116½	113½	120
Gen. G. & E. (Del.) pf. A $7—no par	k108½	100	109½
Gen G. & E. (Del.) pf. B $7	k102	96	105
Gen. Pub. Serv., $7 cum. pf., no par	k109	102	106
Gen. Pub. Serv., com., no par	k 15½	11½	15½
Ga. Lt., Pwr. & Rys., 6% pf.	92	87	96
Ga. Lt., Pwr. & Rys., com.	m 50	50	80
Ga. Ry. & Pwr., 8% pf.	k123	119	125
Ga. Ry. & Pwr., 7% pf.	k113½	106	110
Gt. Western Pwr., 7% pf.	h102½	....	....
IDAHO PWR., 7% pf.	106	103	109
Ill. No. Utilities, 6% pf.	m 96	92	97
Ill. Pwr. & Lt., 7% pf.	101	99	101½
Ingersoll Rand com. $8	k 88	88½	96½
Int. Combus. Engr., com. $2—no par	40	43½	64
Int. Util., Class A—$3.50—no par	k 44	24	45½
Int. Utilities, Class B—no par	6	3	7½
Interstate Pwr., pf.—$7—no par	94	93	98
Interstate Pub. Serv., 7% pf.	100	98	99½
Iowa Ry. & Lt., 7% pf.	98	97	99
JERSEY CENTRAL PWR. & LT. CO., 7% pf.	103½	97½	103
Johns-Manville, com.†—no par	116½	55½	120½

Stock Exchange: *a*Chicago; *b*St. Louis; *e*Philadelphia; *d*Boston; *e*Baltimore; *f*Montreal; *g*Cincinnati; *h*San Francisco; *i*Pittsburgh; *j*Washington. *k*Bid price Saturday, Sept. 17. *l*Bid price Wednesday, Sept. 21. *m*Latest quotations available. †Dividend rate variable.

Stock Quotations of Electric Light and Power and Manufacturing Companies (Continued)

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday Sept. 20	Low 1927	High 1927
KANSAS CITY PWR. & LT. pf.$7	115	112	115½
Kansas Gas & Elec., 7% pf.	*j*105½	103	107
Kentucky Hydro-Elec., 7% pf.	*a* 97	94½	100
Kentucky Sec.,6% pf.	86	83	87
Kentucky Sec., 5% com.	109	110	115
Kentucky Utilities, 6% pf.	100	95	98½
Keystone Pwr. & Lt., pf.	*m* 98	95	100
LACLEDE GAS LT., 12% com.	*k* 230	173½	267½
Lehigh Pwr. Sec., com.—no par.	20½	15	21½
Long Island Ltg., 7% pf.	118	107	112
Long Island Ltg., com.†—no par	150	139	153
Los Angeles Gas & Elec., 6% pf.	102	98	104½
Louisville Gas & Elec., cl. A. $1.75	26½	23½	27½
MAN. ELEC. SUPPLY, cap. $5—no par	53	50	132
Manila Elec., com.†—no par	*k* 48	40	50
Maytag Mfg., com. 50—no par	31½	23½	34½
Memphis P. & L., pf.—$7—no par	108	107	109
Metropolitan Ed., pf.—$6—no par	100½	93	100
Metropolitan Ed., pf.—$7—no par	107	104	108
Metropolitan Ed., com. $5—no par	90	60	72
Middle West Utilities, 6% pf.	*a*113½	110½	113½
Middle West Util., 8% pr. lien	*a*120½	117½	122½
Middle West Util., com. $6—no par ex. div.	*a*113½	108	117½
Midland Utilities, pr. ln. 7% pf.	*a*107½	97½	107½
Midland Utilities, 6% pf. A	*a*103½	96½	103½
Milwaukee Elec. Ry. & Lt., 7% pf.	*k*102	100	103
Milwaukee Elec. Ry. & Lt., 6% pf.	*k* 99	98	101½
Minn. Pwr. & Lt., 7% pf.	*l*106	104	107
Miss. Pwr. & Lt., $8 pf.	*m*101	106	103
Miss. River Pwr., 6% pf.	101	94	103
Miss. River Pwr. 3% com.	62	....	....
Mohawk Hudson Pwr., 1st pf.—$7—no par	107	101½	112
Mohawk Hudson Pwr., 2d pf.—$7—no par	110	98	112
Mohawk Hudson Pwr., com.—no par	31½	20½	32½
Montana Pwr., 7% pf.	*m*106½	118½	106½
Montana Pwr., 5% com.	102½	81½	106½
Montreal Pwr., 7% com.	*f* 93½	....	....
Mountain States Pwr., 7% pf.	100	97	101
Mountain States pwr., com.†	18	....	....
NASSAU & SUFFOLK LTG., 7% pf.	107	98	105
National Carbon, 8% pf.	*a*139	130½	139½
National Elec. Pwr., A†	*a* 24½	22	25½
National Lt., Ht. & Pwr., com.	24	....	....
National, Light, Ht. & Pwr., 5% pf.	70	....	....
National Pwr. & Lt., pf.—$7—no par	108½	101	109½
National Pwr. & Lt., com.†—no par.	24½	19½	26
National Pub. Serv., 7% pf.	*k* 98	93	100
National Pub. Serv., 7% ptc., pf.	113	108	115
National Pub. Serv., A com. $1.60—no par.	21½	18½	24
National Pub. Serv., B com.—no par	18	14	20½
Nebraska Pwr., 7% pf.	*l*110	106	109
Nevada-Calif. Elec., com.	*k* 28	25	31
New Brunswick Pwr., 4% pf.	60	....	....
New Eng. Pub. Serv., pr. ln. pf. $7..	101	98½	101
New Eng. Pub. Serv., pf. $7	97	95	97½
New Orleans Pub. Serv.—7% pf.	103	103	105½
N. Y. & Queens Elec. Lt. & Pwr., 5% pf.	90	91	97
N. Y. Central Elec., 7% pf.	102½	101	104
Newport News & Hampton Ry., Gas & Elec., 5% com.	109	....	....
Newport News & Hampton Ry., Gas & Elec., 7% pf.	109	....	....
Niagara Falls Pwr., 7% pf.—25	28½	27½	29½
Niagara, Lock. & Ont. Pwr., 7% pf.	114	112½	116
No. Amer., 6% pf.—50	53½	50	55
No. Amer., com.—10	59	45½	59
No. Caro. Pub. Serv., pf.—$7—no par	100½	93	102½
Northeastern Pwr., com.	19½	14½	20½
No. N. Y. Utilities, 7% pf.	106	103	109
No. Ohio Pwr., com.—no par	17½	9½	17½
No. Ohio Trac. & Lt., 6% pf.	83	78	81
No. Ont. Lt. & Pwr., 6% pf.	*k* 91	84	95
No. Ont. Lt. & Pwr., 4% com.	72	73	78
No. States Pwr., (Del.) 7% pf.	106	101	107½
No. States Pwr., (Del.) 8% com.	125½	109½	126½
No. Texas Elec., 6% pf.	64	65	70
No. Texas Elec., com.	20	27	36
OHIO BRASS, com. B $4—no par.	84	74	85½
Ohio Brass, 6% pf.	105	100	105
Ohio Pwr., 6% pf.	100½	96	103
Ohio Pub. Serv., $6 pf.	98	95	96½
Ohio Pub. Serv., 7% pf.	105	103	109
Ohio River Edison, 7% pf.	108	103	109½
Oklahoma Gas & Elec., 7% pf.	101½	...	....
PACIFIC GAS & ELEC., 6% pf.	26½	24½	26½
Pacific Gas & Elec., 8% new com.	43	31	43
Pacific Pwr. & Lt., 7% pf.	*l*104½	102	104
Penn Cent. Lt. & Pwr., $5 pf.—no par	*c* 76½	75½	77½
Penn-Ohio Edison, 7% pf.	103½	97½	104½
Penn-Ohio Elec., 7% pf.	*m*101½	98	100
Penn-Ohio Pwr. & Lt., 7% pf.	102	99	103
Penn Pwr.& Lt.—$7—no par.	*l*108½	107	109
Penn Wtr. & Pwr., 8% com., new	*e* 59	47½	59½
Phila. Co., 6% pf.—50	*c* 52½	49½	53½
Phila. Co., com.—50	*k* 106	85½	110
Phila. Elec., 8% com.—25	*c* 56½	46½	57½
Portland Elec. Pwr., 7% pf.	100	97½	101
Portland Elec. Pwr., 6% pf.	80	78	83
Portland Elec. Pwr., 6% 2d pf.	65	55	70
Portland Elec. Pwr., com.	27	22	30
Potomac Elec. Pwr., 6% pf.	*m*108½	....	....
Pwr. Corp. of N. Y., com. $1—no par	*m* 79	....	....
Pwr. Sec., pf.—no par	41	....	....
Pwr. Sec., com.—no par	*k* 11	5	8
Public Serv. of Colorado, 7% pf.	*l*102	99	102
Pub. Serv. of N. J., 6% pf.	*k*100½	98½	101½
Pub. Serv. of N. J., 8% pf.	130	125	132
P. S. of N. J., $2 com.—no par	45½	32	46½
Pub. Serv. of No. Ill., 6% pf.	*a*106½	101½	106½
Pub. Serv. of No. Ill., 7% pf.	*a*117	112½	117
P. S. of No. Ill., com. $8—no par	*a*142	140½	143
Pub. Serv. of No. Ill., $8 com.	*a*142	132	142
Pub. Serv. of Okla., 7% pr. ln.	100	99	100½
Pub. Serv. Elec. & Gas, 6% pf.	107½	102	108½
Puget Sound Pwr. & Lt., 7% pr. pf.	106½	105	107
Puget Sound Pwr. & Lt., $6 pf.—no par	85	....	....
Puget Sound Pwr. & Lt., com.	32½	28	35½
RADIO CORP. OF AMER., $3.50 pf.—50	54½	49	54½
Radio Corp. of Amer., com.—no par.	66½	41½	68½
Republic Ry. & Lt., pf.	*m*120	....	....
Republic Ry. & Lt., com.	*m*135	112	135
Rochester Gas & Elec. 6% pf. D.	*k*104½	101	103½
Rochester Gas & Elec., 7% pf. B	104	105	107
Rochester Gas & Elec., 6% pf. C	104½	101½	103½
SAFETY CABLE, com. $4	68½	52½	74½
San Joaquin Lt. & Pwr., 7% pr. pf.	106	105	108
St. Joseph Ry., L., H. & P., 5% pf.	72	70	73
Servel Corp.	89cts	52cts	10½
Sierra Pacific Elec., 2% com.	*m* 25½	24½	28½
Sioux City Gas & Elec. 7% pf.	103½	99	104
Southeastern Pwr. & Lt., pf.—$7 no par	*l*107	....	....
Southeastern Pwr. & Lt., pfc. pf.	*l* 81	....	....
Southeastern Pwr. & Lt., com.—no par	37	29½	38½
So. Calif. Edison, 8% pf.	40	36½	40
So. Calif. Edison, 7% pf.	*k* 28	27½	28½
So. Calif. Edison, 6% pf.	*k* 25½	24½	27
So. Calif. Edison, 8% com.	38½	31½	39½
Southern Cities Utilities, 7% pf.	*k* 68	67	90½
Southern Cities Utilities, com. $4.	*m* 31½	23½	42½
Southwestern Lt. & Pwr., A $3.	63	60	65
Southwestern Lt. & Pwr., B	63	60	65
Southwestern Lt. & Pwr., $6 pf.	86	83	91½
Southwestern Pwr. & Lt., 7% pf.	*k*109	103	110½
Springfield (Mo.) Ry. & Lt., 7% pf.	102	95	102
Standard Gas & Elec., 8% pf.	64½	57½	64½
Standard Gas & Elec., 7% pr. pf.	109	103	110
Standard G. & E., com. $3.50—no par	63½	54	65½
Standard Pwr. & Lt., 7% pf.	100½	98	102½
Staten Island Edison, pf.—$6—no par	100	99	101
Superheater, $6 com.—no par.	177	170	185
Syracuse Lighting, 7% pf.	110	103	107
Syracuse Lighting, 8% pf.	115½	....	....
Syracuse Lighting, 8% com.—no par	*m*300	....	....
TAMPA ELEC., com. $2.	61	49	64
Tenn. Elec. Pwr., 6% pf.	98	92	99
Tenn. Elec. Pwr., 7% pf.	106½	103	109
Terre Haute, Ind. & East. Trac., 5% pf.	26	20	30
Terre Haute, Ind. & East. Trac., com	1	1	3
Tex. Pwr. & Lt., 7% pf.	*l*110½	106	110
Tide Water Pwr., 8% pf.	107	105	110
Timken Roller Bear., com.—$4 no par.	125	78	142½
Toledo Edison, 8% pf.	116	115	118
Toledo Edison, 7% pf.	*l*105½	102	106
Toledo Edison, 6% pf.	*k* 98	95	97
Toledo Edison, 6% com.	98	....	....
Tri-City Ry. & Lt., 6% pf.	98	90	97
UNITED GAS & ELEC., 6% pf.	101	98	102
United Gas & Elec., com.—no par.	*m* 57	....	....
United Gas & Elec. (N. J.) 5% pf.	72	70	73
United Gas Impr., 8% com.—50	*c*117½	89½	118½
United Lt. & Pwr., pf.—$4—no par.	53	50½	57
United Lt. & Pwr., pf.—$6.50—no par.	*a* 95½	87	97½
United L. & P., com. A .48—no par.	14½	12½	15½
United L. & P., com. B .48—no par.	*k* 19	16	21
Utah Pwr. & Lt., 7% pf.	*l*107	104	108½
Utica Gas & Elec., 7% pf.	105	105	106½
Utica Gas & Elec., 8% com.	200	....	....
Utilities Pwr. & Lt., 7% pf.	95½	93	100
Utilities Pwr. & Lt., com. A $2.	31½	27	34
Utilities Pwr. & Lt., com. B $1—no par.	19½	13½	21½
VERMONT HYDRO-ELEC., 7% pf.	99	95	100
Virginia Elec. & Pwr., 7% pf.	107	105	110
Virginian Pwr., 7% pf.	108	....	....
Virginian Pwr., com.	75	....	....
WAGNER ELEC., 7% pf.	*b* 88	68	90
Wagner Elec., com.—no par.	*b* 33	18½	39½
Washington Ry. & Elec., 5% com.	275	180	275
Washington Ry.& Elec.,5% pf.	95	....	....
Washington Wtr. Pwr., 8% com.	177	136	168
West Penn Elec., 7% pf.	112	102	112½
West Penn Elec., Cl. A $7.	*k*106½	97½	111
West Penn Pwr., 7% pf.	114½	111	118
West Penn Pwr., 6% pf.	*m*108	100½	108½
West Virginia Lt., Ht. & Pwr., 7% pf.	92	94	96
West Va. Utilities, 7% pf.—50	*m* 90	48	51½
Western Pwr., 7% pf.	*k*103	98	101½
Western States Gas & Elec., 7% pf.	100	96	105
Western States Gas & Elec., com.	38	....	....
Westinghouse Elec. & Mfg., 8% com.—50	86½	67½	89½
Weston Elec. Instrument, Cl. A $2—no par.	*k* 31½	30	34½
Weston Elec. Instrument, com.—no par.	12	12	18½
Wheeling Elec., 6% pf.	101	95	104
Worthington Pump, 7% pf. A.	*k* 45	46	61½
Worthington Pump, 6% B.	43	40	54½
Worthington Pump, com.	35½	20½	46
YALE & TOWNE com. $5—25.	*k* 81	70½	84½

Stock Exchange: *a*Chicago; *b*St. Louis; *c*Philadelphia; *d*Boston; *e*Baltimore; *f*Montreal; *g*Cincinnati; *h*San Francisco; *i*Pittsburgh; *j*Washington. *k*Bid price Saturday, Sept. 17. *l*Bid price Wednesday, Sept. 21. *m*Latest quotations available. †Dividend rate variable.

better way to study public relations than to carefully go over the list of shareholders in various cities and towns, weigh the factors of bad industrial conditions, character of population and so forth, and then balance accounts. We do not mean by this that a low customer-ownership saturation is a sure sign of poor public relations or vice versa, but we do say that it is a danger signal and a place where customer-ownership should receive special attention."

Purchase of Day & Zimmermann Approved

Stockholders of the United Gas Improvement Company at a special meeting held Sept. 15 voted to increase the authorized capital stock of the company from 2,036,528 shares, par $50, to 2,130,088 shares, the additional shares to be used in the acquisition of the engineering and public utility firm of Day & Zimmermann, Inc., of Philadelphia, and stock of several gas companies operating in Connecticut. Shareholders of the company also voted to increase the number of directors to twelve, including the president, who is an ex-officio member of the board.

Three new directors were elected as follows: Thomas S. Gates, of Drexel & Company and J. P. Morgan & Company; Charles Day, chairman of the board of Day & Zimmermann, Inc., and Morris W. Stroud, president of the American Gas Company. Mr. Gates is also a director of the Public Service Corporation of New Jersey and 42 of its subsidiary companies. He and Mr. Day attended the directors' meeting, but Mr. Stroud is at present in Europe.

SELLING COSTS PER SHARE FOR SIX COMPANIES

(Includes all known expense. Selling ranges from $75 to $103 per share.)

	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
Employee commissions	$1.48	$1.85	$1.43	$1.87	$2.24	$1.72
Outside salesmen and general expense	0.81	2.15	3.05	2.02	1.75	3.18
Advertising	0.21	0.44	2.26	2.24	1.54	2.29
Prizes and banquets	0.05	0.07	0.11	0.44	0.21	0.25
Traveling and personal expenses	0.02	0.30	1.69	0.54	0.39	1.17
Miscellaneous	0.09	0.40	0.23	0.70	0.61	0.33
Total cost per share sold	$2.66	$5.21	$8.77	$7.81	$6.74	$8.94

ADIRONDACK MERGER APPROVED.—Stockholders of the Adirondack Power & Light Corporation on Sept. 1 ap-

proved of the consolidation of that company with five other companies into the new company known as the New York Power & Light Corporation. Details concerning the formation of this company were given in the Aug. 20 and the Aug. 27 issues of the ELECTRICAL WORLD. This action completes the ratification of the merger by all companies involved, including the Municipal Gas Company of Albany, Troy Gas Company, Adirondack Electric Power Corporation, Fulton County Gas & Electric Company and the Cohoes Power & Light Corporation.

SHAWINIGAN STOCKHOLDERS TO SUBSCRIBE FOR ADDITIONAL SHARES. — Stockholders of the Shawinigan Water & Power Company of record Sept. 30 will be given the right to subscribe on or before Nov. 15 for 100,000 additional shares of common stock (no par value) at $50 per share in the ratio of one new share for each eleven shares of common stock held. The company announced that on Jan. 1, 1928, it will redeem 5 per cent consolidated mortgage gold bonds, due Jan. 1, 1934, to the amount of $3,263,000 at 110 and interest. The original issue amounted to $5,000,000.

TIDE WATER POWER TO PAY QUARTERLY DIVIDENDS.—Dividends on the 7 per cent and 8 per cent preferred stock of the Tide Water Power Company, a subsidiary of the National Public Service Corporation, which formerly have been paid monthly, will be paid quarterly, effective Oct. 1, on which date the last monthly dividend (for September) will be paid.

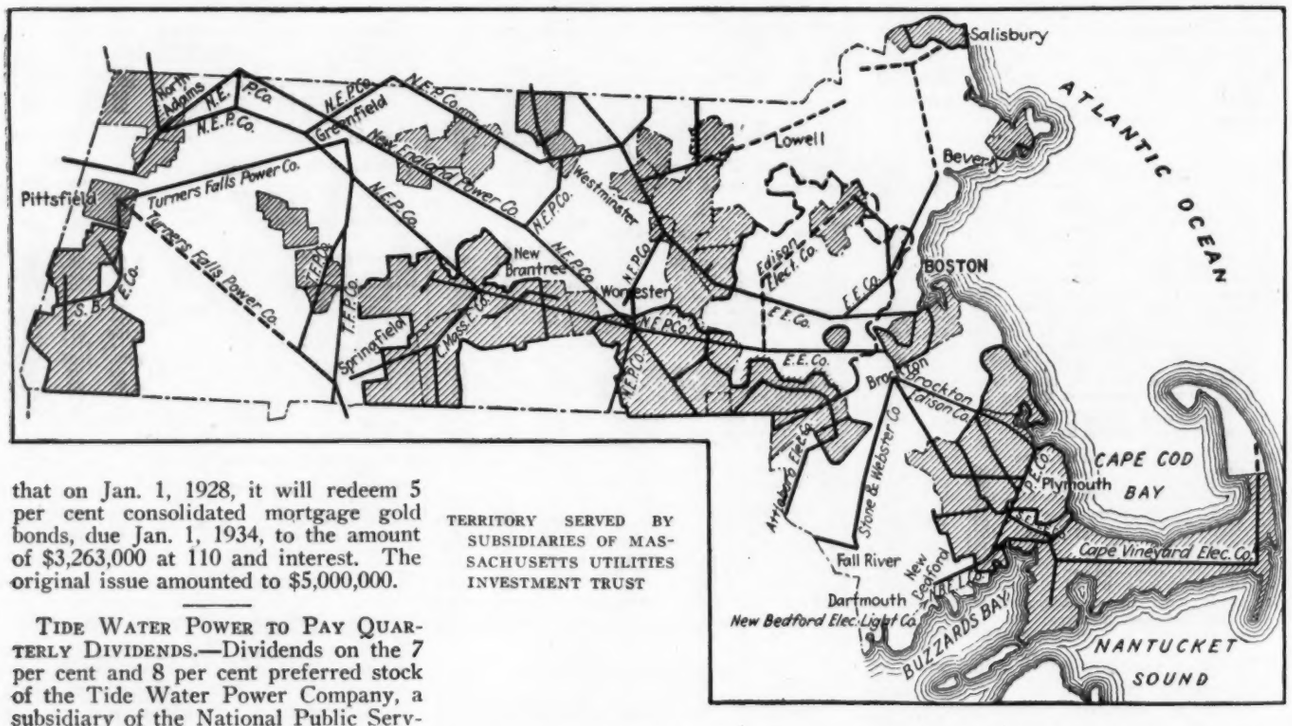
Public Service Corporation Adds Ten Thousand Stockholders

A total of 10,572 new names were added to the stockholders' list of the Public Service Corporation of New Jersey during the six months ended June 30, 1927, according to official figures recently made public. As a result of this gain the company had on its books, June 30, 1927, the record-breaking total of 62,572 names covering all classes of stockholders, but eliminating all duplications where holders own either common and preferred or more than one class of preferred stock. The total of 62,572 individual stockholders reported on June 30 compared with total stockholders numbering 52,000 reported on Dec. 31, 1926.

Sales of electric energy by the Public Service Electric & Gas Company, principal operating subsidiary of the Public Service Corporation of New Jersey, totaled 606,160,632 kw.-hr. during the first six months of 1927 compared with sales of 513,252,592 kw.-hr. reported for the same period last year, or an increase equal to more than 18 per cent during the period.

Massachusetts Utilities Investment Trust Now Important Factor

REFERENCE has been made in these columns to the recent formation of the Massachusetts Utilities Investment Trust, under which 45 public service companies affiliated with the Massachusetts Lighting, C. D. Parker and Webber interests of Boston have been grouped under a centralized holding organization whose securities are being widely marketed in the Bay State. From 62 to 100 per cent control is now owned by the trust in the subsidiary companies, which serve 94 cities and towns in Massachusetts with a total population of nearly 600,000.



TERRITORY SERVED BY SUBSIDIARIES OF MASSACHUSETTS UTILITIES INVESTMENT TRUST

At the end of last year these companies had 56,501 gas customers and 97,602 electric light and power customers, the latter purchasing during 1926 154,817,900 kw.-hr. Since 1920 the gross annual income of these companies has increased from $5,962,100 to $9,546,700. As of Oct. 1, 1927, the outstanding bonds of the operating companies will total $1,123,200. The capitalization Sept. 1 consisted of 422,324 outstanding convertible participating 5 per cent preferred shares (expressed value $50) and of 1,157,976 outstanding voting trust no-par common shares.

To the list of trustees previously printed there have now been added Frank D. Comerford, director of the New England Power Association; Luke C. Bradley, president of the Narragansett Electric Lighting Company; Francis P. Sears, vice-president of the Columbia National Life Insurance Company; J. J. Bodell, of Bodell & Company, Providence, R. I.; C. L. Edgar, president Boston Edison company; James J. Phelan of Hornblower & Weeks, Boston; Channing H. Cox, vice-president First National Bank of Boston; Philip Stockton of the Old Colony Trust Company, Boston; Arthur E. Childs, Edwin H. Barker, Philip M. Childs, Guy W. Cox, Myron L. Whitcomb and Henry A. Wyman. The financial management of this group is thus broadened to include representation from some of the most important utility and banking interests in the Northeast. The territory served by these companies, with the principal transmission developments now in use and in prospect in Massachusetts, is shown in the accompanying map.

Business News and Market Conditions

New French Tariff Hits the Electrical Industry

The new French tariff, which recently became effective and involves about $80,000,000 worth of American manufactured goods sold in France every year, virtually includes all electrical apparatus except electric tools under the general tariff. American wireless apparatus will pay a 58 per cent higher rate than that from countries which benefit by the minimum rate, and electric dynamos, magnetos and all telegraph and telephone instruments will pay the high rate, which in some cases is almost prohibitive. Absolute maximum duties have been applied to these manufactured articles. This was a surprise to Americans, who were led to believe that an average rate would be accorded American products.

In view of the impending negotiations for a French-American treaty of amity and commerce, it is not believed the French will easily be induced to relinquish such a formidable trading argument. France is anxious to obtain the most favorable tariffs for her luxury trade in the United States, a trade which represents a good proportion of the $152,000,000 worth of goods exported to America every twelve months. It is the impression of American business men in Paris that the last-minute decision to apply the highest tariffs to American products was made in view of the approaching trade negotiations with the United States government. Certainly it accords France a distinct advantage.

Germany at Advantage

The signing of the Franco-German commercial treaty, recently accomplished, which gives to Germany the most-favored-nation treatment, in conjunction with the new tariff now accords to Germany a distinct advantage as regards the United States, with which she was competing in the French market. Electrical equipment, machinery of all kinds, textiles, chemicals and numerous specialties are particularly affected. American products being taxed four times as much as those of Germany, it is asserted that it will not be long before Germany will have captured 20 to 30 per cent of American trade with France. As indicative of the progressiveness of German industry (which was recently covered in an article in the Electrical World by Edward J. Mehren, vice-president of the McGraw-Hill Publishing Company, Inc., who made a survey of the situation), it is reported that Germany, in anticipation of such a turn of events, has prepared immense shipments of goods for dispatch to France.

Since the Franco-German treaty has become effective these shipments are being made daily and German salesmen have been offering many inducements to buyers in the way of long term credit and have even gone so far as to extend ready cash to such firms as needed it, owing to bad economic conditions, to carry them over depressing periods. On the other hand, American manufacturers, who were not anticipating such a turn of events, have only normal shipments en route to France and in many cases have made contracts based on the old tariff.

With a view to relieving the situation the United States has made representations to France suggesting the suspension of any higher duties on American than on German or other goods pending the negotiation of a commercial treaty between the United States and France. The American Embassy at Paris has been instructed by the Department of State to make representations to the French government against the increased handicaps on American trade with France, expressing the readiness of the United States to proceed at once with negotiations for a commercial treaty and requesting assurance from France that pending the consummation of the treaty negotiations no higher duties be imposed upon American goods than upon similar goods of German origin. The reply of the French government to these American proposals is expected at an early date.

British Electrical Industry and Trusts

Survey of Manufacturers' Association Shows that Individual Policies Must Give Way to Unified System—International Competitive Situation

THIS review of a survey made by the British Electrical and Allied Manufacturers' Association points out that too much concession is still made to the theory of individual concerns with individual policies and badly regulated conditions of production and price. The rapid growth of power finance is said to be undoubtedly a feature of very real significance, and the cooperation of the banks in power development and in the expansion of markets open to the electrical manufacturer has become an exceedingly important factor in the competitive situation, notably in Germany, France, Belgium, Italy and Switzerland. Finally the report suggests that the financial policy must change if prosperity is to return to British industry or it will be actually necessary for industry to evolve its own financial system to meet the needs of the situation.

THE economic and statistical department of the British Electrical and Allied Manufacturers' Association has just published a study of "Combines and Trusts in the Electrical Industry," after careful research, at a cost of $26.25 per copy. The publication is stated to have been undertaken primarily with a view to discovering the real facts of the international competitive situation and to unraveling the system of international affiliations and associations, both in electrical manufacture and in power finance, which has characterized the post-war period.

The electrical industry, it is stated in the introduction, has been subjected to the criticism that it has lent itself in Britain to the formation of "rings" and "combines," intended to maintain prices and control production, while it has been confidently stated by the same critics that European competitors observe the open-market doctrine and avoid combinations. It has suffered from much misconception of its activities and its competitive organization in the past, and there is no guarantee that it will not suffer again in the future unless the truth of the international situation is shown. It is fighting above all for the 180,000 employees it carries on its pay rolls and for the 1,500,000 population who depend on its activity, directly and indirectly. It has, through the effective combination and the observance of reasonable standards of production and price, maintained its position against foreign competition of the most determined nature. It has become the leading export branch of the engineering industry and brought Britain easily into first place among the exporters of the world in electrical goods. It has more than doubled in fourteen years the number of its employees and kept them in steady employment during a period of unprecedented trade depression. The time is past, therefore, the report says, for the electrical manufacturers to apologize for a system which has contributed to national prosperity and served to uphold the fairest British standards of quality and workmanship in the markets of the world.

The four main subjects with which the volume deals are industrial organization, power finance, international competition and the relations between finance and industry. In regard to the first it is stated to be clear that the movement toward the formation of a single trust covering the whole of the industry is far advanced in Germany and France, while the principle of the large

manufacturing unit has been observed in the United States as well. The tendency is for the trust to bring as many firms as possible into its system, allow the central association to combine the remaining producers, and so effect unity of policy and of action. The possibility of the smaller firms ruining the market through price cutting or through the offer of special discount, delivery and guarantee conditions, with the prospect of a fierce struggle between them and the trust, is entirely avoided, and the whole industry moves forward with a certain degree of balance and symmetrical adjustment.

In face of this movement the British electrical industry, it is declared, has two possible moves left—either to form closer associations with American and German manufacturing concerns, and so become absorbed in the international combine which might be formed ultimately, or to tighten up its own organizations, form a compact group of manufacturers with a common policy both in manufacture (prices and orders) and in finance, and at the same time strengthen the central association. It cannot continue in the present system, where too much concession is still made to the theory of individual concerns with individual policies and badly regulated conditions of production and price, and remain in existence. Hitherto, it has, on the whole, been extremely successful in the home and overseas markets, but it has still to experience the competition of international groups with very great financial and political resources. It can meet that competition if it combines now more effectively than hitherto, but, on a conservative estimate, it has not more than two years in which to effect the necessary changes before the testing period will come. It is not a question of technical but of administrative efficiency.

In power finance the great manufacturing firms of the United States and Germany before the war carried out a wholly successful policy of financial penetration into overseas markets through the formation of power finance corporations, which raised the capital required for new power schemes, created in a number of cases special supply undertakings and acted as technical and financial consultants. The war and its aftermath destroyed much of the system so carefully prepared in Germany, and the balance of strength in power finance has now shifted to Switzerland and Belgium. The rapid growth of power finance is undoubtedly a feature of very real significance. Existing organizations in Britain, where foreign controlling interests do not dominate policy and so render them largely ineffective as far as the manufacturer is concerned, are not adequate to the needs of the situation, and an effort should be made to develop large-scale power-finance groups capable of dealing with superpower schemes in any market. The only alternative lies in closer association between British manufacturers and the powerful organization already operating in Belgium and, possibly, the United States.

The international competitive situation has been fundamentally affected by the growth of large power-finance corporations connected with electrical manufacturers. Belgium, France, Italy, Germany and Switzerland may be considered as closed preserves so far as the British electrical exporter is concerned. In those countries the entire national output of electricity is controlled, directly and indirectly, by manufacturing groups, some of them international in character, and the only entrance which can be effected into the market comes from either the technical or the industrial side. Even if all tariffs were swept away, the British electrical manufacturer would benefit only very slightly on the heavy plant and industrial motor side, since the market would be so completely controlled through finance and trade associations that no inquiries would reach him. A great part of the world still remains open, but the affiliations of American manufacturers in Japan, Central and South America, the West Indies and Mexico, as well as Canada, must be taken into account before the world position can be correctly assessed.

The co-operation of the banks in power development and in the expansion of markets open to the electrical manufacturer has become an exceedingly important factor in the competitive situation, notably in Germany, France, Belgium, Italy and Switzerland. The industrial banks participate directly in the capital increases of power companies and industrial firms, and while they possess holdings in electrical manufacturing concerns, they are in a position to advance credits or guarantee credits obtained in the international money market. The German manufacturer at the moment can grant credits of a long-period nature to large power companies abroad, since he knows it is an easy task to float a loan in London or even New York on behalf of the latter, and allow the British or American investing public to pay the price of the important contracts obtained by him. He can take payment, where the security is good, in bonds and place them on the market through the banks and in many cases actually make an additional profit on them.

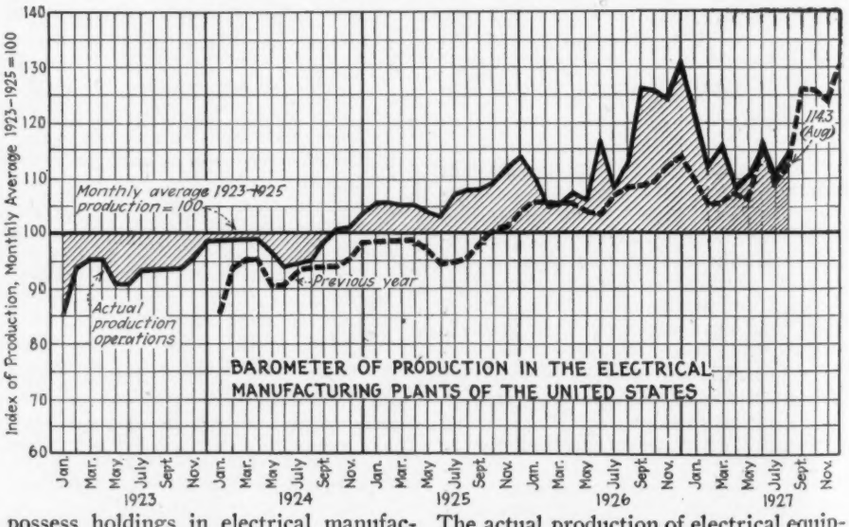
Finally, it is suggested that the financial policy must change if prosperity is to return to British industry, or it will be actually necessary for industry to evolve its own financial system to meet the needs of the situation. The development of the power finance corporation, coupled with the formation of large industrial credit institutions, appears the most effective method of insuring better financial and marketing conditions for British electrical goods. The electrical industry is ready to co-operate with finance when conditions are favorable to co-operation, but the realization of favorable conditions must mean a fundamental change in the policy not merely of financial institutions, but also of the Bank of England and the State.

Production Activity During August Down

August Productive Activity 2.6 Per Cent Under 1926—Eight Months' Production 3.8 Per Cent Over Same Period Last Year

THAT the electrical manufacturing plants of the nation are operating very close to the same level as at this time last year is indicated by reports received by the ELECTRICAL WORLD on the monthly consumption of electrical energy by a large portion of these plants.

(Data Unadjusted for Seasonal Variation)



The actual production of electrical equipment and supplies during August was about 3.8 per cent over that reported for July, but after correction is made for the fact that August had two more working days than July, it is found that the rate of production recorded during August was 3.7 per cent under that of the former July. The August activity was also about 2.6 per cent under that of August last year, although, since there was one more working day, the actual production during the current month of August was about 1.3 per cent over August, 1926.

The electrical manufacturing plants have been operating at a fairly stable rate since February, and with the exception of June and July the production of these plants has been above that of the same month last year. The actual production during the first eight months of the current year has been about 3.8 per cent over that during the same period of 1926 and 7.1 per cent over 1925, a very creditable growth in the operations of the industry.

The trend of production in the electrical manufacturing plants is following with a fair degree of closeness the operations as reported by industry as a whole. General industry during August was operating at a rate about 0.3 per cent under that witnessed during August last year. This is the first month since February that national general productive operations have been under those reported during 1926. Operations in general were very irregular during August. Within the same industries and in the same sections of the nation manufacturing plants reported opposite tendencies. In industries in which the general trend in rate of production during the month was upward many manufacturing plants reported a material drop in operations, while some plants reported near-record activities when the general operating trend of the industry was downward. The manufacturing industry appears to be marking time awaiting the upward impulse through the channels of distribution.

Market Conditions

SALES in the elecrical industry are showing a slightly upward tendency, though spotty. Manufacturers express optimism regarding the outlook, and although no especially big business is contemplated there is no expectation of any falling off in orders. The purchases of a large utility company in the Middle West are now averaging $71,000 per day.

In the New England district slightly improved buying is noted, and motor sales are steady. Industrial and commercial lighting negotiations are gaining in volume and appliance sales show little change. Central-station buying shows improvement in the New York district and sales of transformers and switching equipment are good. A satisfactory volume of sales with few large orders sum up the activities in the Southeast. Several small-sized motor orders were received from industrial plants. Manufacturers in the St. Louis district report that sales are being maintained at the normal rate. There has been a good demand for heating and cooking appliances and electric advertising equipment. In the Middle West business is gradually improving and utility buying is increasing. On the Pacific Coast a large volume of small orders is being placed, good contracting business is reported and some large pulp and paper mill sales are in immediate prospect.

Copper Market Active— Lead Sales Improve

A much larger business in copper, with all sellers participating at 13¼ cents delivered in the East, has been the feature of the non-ferrous metal markets. Lead has also sold in improved volume and the St. Louis price has advanced to 6.075 cents. The large producers, who have been holding their copper at 13¼ cents, delivered Connecticut for over a month without placing much business, have recorded sales larger than for any week in two months. In the East 13¼ cents was generally realized, with a fair amount of business in the Middle West at 13⅜ cents. Last week Thursday and Friday were the largest days, but business has been well over 1,000 tons a day for the first three days of this week. Buying has been general among brass, sheet copper and wire mills and has been largely for October shipment. Galvanizers have shown little interest in zinc, and tin has been declining steadily despite the present low prices.

NEW YORK METAL MARKET PRICES

	Sept. 14, 1927 Cents per Pound	Sept. 21, 1927 Cents per Pound
Copper electrolytic	13.225	13.20—13.25
Lead, Am. S. & R. price	6¼	6¼
Antimony	11¼	10¾—11
Nickel, ingot	35	35
Zinc spots	6.60	6.55
Tin, Straits	65¼	60¾
Aluminum, 99 per cent.	26	26

Base copper price Sept. 21, 1927, 15¼ cents.

Slightly Improved Buying Noted in New England

A slight betterment in buying is noted in the New England district. Negotiations for heavy equipment are temporarily quiet, but small motor sales are steady. One order for about $10,000 worth of motors was recently closed for Maine delivery, orders amounting to about $60,000 are pending and the number of single orders is reported to be maintaining a fair level. Central-station buying is quiet, new construction requirements have been spotty and wire and cable sales continue to show a steady trend.

Industrial and commercial lighting negotiations are gaining in volume and appliance sales show little change. The Abington & Rockland Electric Light & Power Company has started the construction of a new substation which will have an ultimate capacity of 6,000 kva. This station is to be ready for occupancy Jan. 1. The order recently placed by the New England Public Service Company, Augusta, Me., with the Westinghouse Electric & Manufacturing Company for oil circuit breaker and transformer equipment amounted to $250,000 instead of $750,000, as reported in the issue of Sept. 10.

Utility Buying Improves in New York District

The market for electrical apparatus among central-station companies in the New York district shows a little increase in activity and inquiries are more numerous. Sales of switching equipment are good and transformers are in better demand than they have been for some time. There are also numerous inquiries reported for substation apparatus. Pole, crossarm and hardware sales are quiet and there is little demand for circuit breakers. Motors are being purchased in good volume by industrial buyers, considerable improvement being reported in the demand for larger-sized machines, while the market for small motors continues strong. Jobbers report a spotty market, with appliances showing a tendency toward weakness.

Good Volume of Small Orders Being Placed in Southeast

A satisfactory volume of small orders with few individual large orders sum up the electrical activities in the Southeast. The largest central-station order reported was for No. 6 weatherproof solid copper wire amounting to $16,500, while another wire order was for $5,000 worth of No. 2 and No. 10 weatherproof stranded copper wire. Sales of small transformers and meters continue generally good over the territory, one company's purchases of distribution and small power transformers amounting to approximately $13,000 and its meter orders about $7,200. In connection with one company's activities regarding the change of its direct-current service to alternating current was the placing of orders for $4,000 worth of printing press motors and $2,700 worth of miscellaneous elevator equipment. Some other power company business included orders for $2,100 worth of insulators and $2,100 worth of aluminum cable.

Manufacturers report a reasonably good number of small-sized motor orders from industrial plants. Three small electrification jobs were let in South Carolina and one in Georgia. Each of these jobs will call for approximately $7,000 worth of electrical materials and equipment.

Large Volume of Small Orders Placed on Pacific Coast

Much miscellaneous small business is reported on the Pacific Coast although there are few large orders. The Modesto Irrigation District awarded orders for 45 miles of 60-kva. steel tower power line from the Dom Pedro dam and power house. The insulator order was

placed with the Ohio Brass Company. The Pacific Gas & Electric Company has ordered from the Graybar Electric Company a carrier-current system to serve from the Pit River power station to the Bay District to give auxiliary telephone service over the 220,000-volt line. A power company is now in the market for two carloads of pole line hardware for its East Bay warehouse. Railroad buying is fair and limited to car and shop wiring supplies. The State of California bought 3,500 ft. of 500,000-circ.mil and 1,000 ft. of 300,000-circ.mil rubber-covered cable. Jobbers report good contracting business, particularly in the territory influenced by excellent crop and canning conditions, although canners have had difficulties in coming to terms with some growers such as the peach farmers. Excellent prospects are reported for elevator and ventilating equipment. Rubber-covered wire prices have declined 5 per cent and rigid iron conduit 2 per cent.

Lumber mill and industrial buying has been very light. A good volume of motor and apparatus sales to pulp and paper mills is in immediate prospect. The city of Seattle within the next 60 days will place an order for approximately $500,000 worth of weatherproof wire. The city of Seattle also bought $18,600 worth of distribution transformers and $5,000 worth of poles. The Puget Sound Power & Light Company bought one carload of crossarms. A jobber reported the sale of 40 motors from 50 hp. down, mainly to dealers, and another jobber sold fifteen 1-hp. motors for apple cleaning machines in eastern Washington. The Seattle Board of Public Works awarded a contract for the construction of a concrete arch dam across the Skagit River at Diablo Canyon as a part of the Skagit hydro-electric development to the Winston Brothers Company of Minneapolis for $2,362,738.

Business Gradually Improving in Middle West

The volume of business in the Middle West is gradually getting larger with increased industrial and seasonal activity. An optimistic feeling is evident most everywhere and it is believed that fall business will be good. The various utility companies are busy and commitments are running quite heavy, averaging approximately $71,000 per day for one large utility company as compared to $65,000 per day a month ago. Considerable purchasing of apparatus is recorded and quite a lot of construction work is under way. Interesting orders placed covered complete boiler settings for six B. & W. boilers, one 30,000 cu.ft. per minute rotary air filter, eight 60-in. double disk low-pressure motor-operated gate valves, 400 direct-current watt-hour meters and a 50-kw. broadcasting transmitter complete with structural steel towers and all appurtenances valued at $190,000.

Jobbers' sales continue to increase slowly. Considerable preparation is under way for the holiday trade and a large amount of appliance business is being anticipated. Appliance sales continue steady with a good demand for vacuum cleaners, one jobber placing an order for 3,000 machines. Code wire prices advanced from 1 per cent to 3 per cent. Indications of a price war among the manufacturers of fuse plugs are seen in a reduction of $1 per thousand plugs.

Sales in St. Louis District Continue at Normal Rate

There has been no appreciable change in general conditions in the St. Louis district. Manufacturers all report that the volume of business is being maintained at a normal rate. An order for motors from 5 hp. to 100 hp., aggregating $25,000, was received for shipment to Arkansas; another order for elevator motors amounting to $6,750 was received from western Missouri. Two orders of note cover small generators, switchboard and vapor-proof fittings for an oil pumping station, amounting to $5,000, and a substation with switchboard, outdoor switches and mechanism complete costing $14,000. Both of these orders are from the southwestern part of the district. Two small generators, one 200 kva. and the other 300 kva., were also sold in the southwest section of the district at a price around $5,000. There has been somewhat better demand for heating and cooking appliances, and some good wiring jobs have been let in the last few days. Several good contracts for electric advertising equipment have been reported.

Activities of the Trade

Cutler-Hammer Secures Rights for Harland Control

The United States rights for the Harland scheme of control for paper-making machines has been granted to the Cutler-Hammer Manufacturing Company, Milwaukee, by the Harland Engineering Company of London, England. The Cutler-Hammer company has recently booked orders for Harland control and will supply two units to the Fraser Paper, Ltd., of Matawaska, Me., and one unit to the Mead Fiber Company, Kingsport, Tenn.

Carborundum Company Buys American Resistor

A controlling interest in the American Resistor Corporation, Milwaukee, has been purchased by the Carborundum Company of Niagara Falls, N. Y. The principal products of the American Resistor Company are non-metallic electrical heating elements and resistors, which are marketed under the trade name of Globar. The new company will be known as the Globar Corporation and has been incorporated under the laws of the state of New York with a capital of 16,700 shares of no par value stock and an issue of $650,000 in 7 per cent ten-year debenture bonds.

The present manufacturing facilities of the old company will be moved to Niagara Falls, N. Y., where a new plant will be erected in connection with the plant of the Carborundum Company. In the reorganization the former officers of the American Resistor Corporation, Joseph A. Steinmetz, president; W. E. Duersten, vice-president, and Walter W. Perkins, vice-president and treasurer, have been succeeded by Frank J. Tone, president; George R. Rayner, vice-president; F. H. Manley, treasurer, and Arthur Batts, secretary. These new officers occupy similar positions with the Carborundum Company. These officers are also directors of the Globar Corporation, together with Messrs. Steinmetz, Perkins and Sharpe of the old group. W. E. Duersten has been appointed general manager of the Globar Corporation.

Westinghouse Gets Condenser Order from Brooklyn Edison

The Brooklyn Edison Company, Brooklyn, N. Y., has ordered from the Westinghouse Electric & Manufacturing Company a single-pass surface condenser for use with the 147,500-hp. turbo-generator to be installed in the Hudson Avenue power station next year. Its cost, including auxiliaries, will be about $350,000. The Brooklyn Edison Company has also ordered from the Westinghouse company four mechanical stokers for use with boilers developing 2,400 hp.

Miller Company Consolidates Subsidiaries

The Miller Company, Meriden, Conn., manufacturer of lighting fixtures, has increased its capital by doubling the number of shares of no par value stocks, making the outstanding issue 32,000 shares. The company also has outstanding $800,000 in 6½ per cent preferred stock. Consolidation of Miller Company subsidiaries is also announced. The Monowatt Electric Import Company has been brought into the group and the business will be transferred to Meriden. The New England Metal Products Company and the Connecticut Molded Products Company, newly organized, also will be brought together in the Miller group. The officers of the Connecticut Molded Products Company are: Roy E. Coleman, president; Ernest C. Wilcox and W. F. Minor,

vice-president, and Hewitt Warburton, secretary and treasurer. The Connecticut Molded Products Company will acquire the branch factory of the Connecticut Telephone & Electric Company and patent rights in the cold molded products invented by Mr. Coleman.

THE WALTER BATES STEEL CORPORATION, Gary, Ind., manufacturer of steel poles, towers, floor grating, etc., announces that H. Douglas Stier, formerly general sales manager of the Railway & Industrial Engineering Company and later Western sales manager of the American Brown Boveri Electric Company, is now associated with the company and will be located at Gary.

THE REYNOLDS ELECTRIC COMPANY, 2650 West Congress Street, Chicago, manufacturer of color hoods, flashers for electric signs, etc., has placed on the market a new device called a colorhood holder to be used in connection with "Reco" color hoods.

THE LEONARD REFRIGERATOR COMPANY, Grand Rapids, Mich., announces a new Leonard cleanable model built exclusively for use with an electrical unit. The company also announces that its 1927-28 line is now on the market and is equipped for use with ice or any electrical unit.

THE NEW DEPARTURE MANUFACTURING COMPANY, Bristol, Conn., manufacturer of the New Departure ball bearing, has established a branch engineering office at 1812 Van Ness Avenue, San Francisco. Elliott A. Allen has been appointed resident manager.

THE LAPP INSULATOR COMPANY, INC., Le Roy, N. Y., announces the establishment of a New York City office at 149 Broadway, Singer Building, in charge of Ralph L. Jenner, who was recently with the transmission engineering department of the Philadelphia Electric Company. The Shield Electric Company has ceased to represent the Lapp company.

THE TRUMBULL-VANDERPOEL ELECTRIC MANUFACTURING COMPANY, Bantam, Conn., manufacturer of "TV" safety switches, announces that it is now prepared to furnish its new line of current-breaker safety switches in cast iron boxes for use in steel, flour, cement and other mills of this type, mines, railroads, and for any industrial purpose where dustproof, waterproof and fumeproof safety switches are necessary. These current breakers are made in capacities from 30 amp. to 1,200 amp.

THE ROYAL ELECTRIC MANUFACTURING COMPANY, 556 East 40th Street, Chicago, manufacturer of high-tension switching equipment and high-tension fuses, has arranged to move into larger quarters. The new building at 618 East 40th Street is a two-story brick factory building with about 30,000 sq.ft. of available floor space. The company has also purchased adjacent vacant real estate for future building expansion, and will be completely moved into its new quarters in about 60 days.

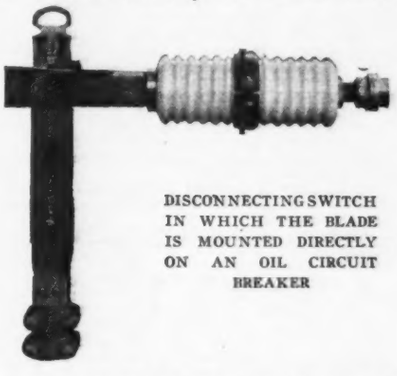
New Equipment Available

Chain Drive

A new type of chain operating on the same principle as the original Morse rocker joint has been developed by the Morse Chain Company, Ithaca, N. Y. The improvements are principally owing to changes in the design of the rocker joint. The new-design "55"-type chain will run on all sprockets since the new link is the same length and height as the old. The new chain is said to be more rugged, the joint pins are about 8 per cent heavier, and the breaking strength is increased about 50 per cent. This improvement permits increased tension without shortening the life of the drive. The company also announces that it has installed modern automatic electric furnaces to insure uniform heat treatment of all the parts entering into the chain.

Disconnecting Switch

A new disconnecting switch manufactured by the Delta-Star Electric Company, 2400 Block, Fulton Street, Chicago, is so designed that the blade is mounted directly on an oil circuit breaker stud and is adjustable to the proper height by means of a sliding sleeve. The floating contact jaws are mounted on a stud passing through a porcelain tube which in turn can be clamped to the proper height. This switch is equipped with a lock which locks in either open or closed positions. When the oil circuit breaker has to be removed it is only necessary to open the disconnecting switch and withdraw the breaker.



DISCONNECTING SWITCH IN WHICH THE BLADE IS MOUNTED DIRECTLY ON AN OIL CIRCUIT BREAKER

Three-Ton High-Lift Truck

The Yale Model K25 3-ton high-lift elevating truck has been added to the line of the Yale & Towne Manufacturing Company, Stamford, Conn., in order to fulfill the requirements for increasing loads on electric industrial trucks. The elevating platform is raised and lowered through the medium of a 1½-in. diamond roller chain, passing over a power-driven sprocket at the bottom, and an idler sprocket at the top. In order to reduce friction to a minimum Hyatt heavy-duty roller bearings are employed in the idler sprocket. The shifts of the lower sheaves run in a bath of oil, which also serves to lubricate the spur-gear reduction unit.

The two ends of the roller chain are attached to the left truck platform through a spring take-up device, which will automatically adjust itself as the chain wears. The main-drive unit is of the double reduction spur-gear type, driving the wheels through totally inclosed universal joints. The entire gear reduction with its differential and bearings run in a bath of oil. The steering system is fitted with ball and roller thrust bearings. A four-wheel steer feature allows a turning radius of 96 in. to the outside edge of the truck. Servicing or watering of the battery can be performed without sliding it out. The battery may be removed by hoisting it out of the battery box or else by removing the side plate to the box and sliding the battery out sideways.

CABLE CUTTER.—The "Starrett" cable cutter for cutting wire cable and holding the blunt ends has been placed on the market by Horace Hills, Inc., 1535 California Commercial Union Building, San Francisco. The cutter will handle any size cable up to 1 in. in diameter, leaving both of the cut ends incased in a steel band by one operation. The steel band used is a thin sheet of tough pliable steel indented with a groove and lock seam at one end and made in various lengths to fit any size cable. This band allows the cable to be passed through any socket or opening of its own size. The cutter is only 6 in. high and 3 in. x 3½ in. at the base and weighs less than 12 lb.

BOILERPLATE INCLOSING CASES FOR STARTERS. — Dust-tight boilerplate inclosing cases for wall-mounted, general-purpose starters are announced by the General Electric Company. These cases are recommended for very dusty installations, such as foundries, cement mills, etc., for installations where mechanical strength is desired, such as steel mills and coal mines, and for installations where protection against steam or fumes is necessary, such as paper mills. The cases are constructed of ¼-in. boilerplate steel with welded joints. This forms a dust-tight joint. The front is covered by a boilerplate door which swings on interchangeable hinges, opening either to the right or the left. This door is clamped against the machined surface of the boilerplate case by means of thumb screws. A vellumoid gasket is cemented to the inclosing case, and this insures a good dust-tight fit between the cover and the case proper. Conduit openings are provided for bringing the leads to the case.

Electrical Patents

Announced by U. S. Patent Office

(Issued Sept. 6, 1927)

1,641,159. LAMP SOCKET; H. C. Foster, Connersville, Ind. App. filed Nov. 20, 1926. For use in vehicle lamps.

1,641,170. LIGHT-OPERATED CONTROLLING APPARATUS; G. V. Karlson, Elizabeth, N. J. App. filed April 15, 1926. Whereby a lamp is ignited in darkness or cloudy weather and is extinguished in the daylight.

1,641,197, 1,641,198, 1,641,199, 1,641,200. SYSTEM FOR TRANSMITTING VARIABLE CONDITIONS; E. Roucks, Blansko, Czechoslovakia. Apps. filed Jan. 2, March 14 and Aug. 20, 1923. For transmitting variations in any quantity, quality or condition, for instance, fluid pressure, electric current, temperature, etc., including a recording system.

1,641,201, 1,641,202. AUTOMATIC EXCESS-CURRENT SWITCH WITH ELECTROMAGNETIC AND THERMIC RELEASE; S. Ruppel, Frankfort-on-the-Main, Germany. Apps. filed May 1, 1926.

1,641,203. ELECTRIC FUSE INDICATOR; F. Scordamaglia, Brooklyn, N. Y. App. filed March 3, 1926. Indicating by a glowing lamp that the fuse has blown.

1,641,219. SWITCH MECHANISM; C. P. Bradley, Napoleon, Ohio. App. filed March 25, 1926. Switch constructions adapted for use in electric light sockets, wall boxes, chandeliers, or other forms of electric fixtures for controlling one or a plurality of lamps through the operation of a single pull-chain or push-button.

1,641,223. CONTACT RECEPTACLE; A. C. Gaynor, Stratford, Conn. App. filed April 23, 1924. Adapted to receive jacks or blades arranged either in parallel or in tandem.

1,641,241. MANUFACTURE OF LEAD ELECTRODE FOR ACCUMULATORS; A. Strasser, Rorschach, Switzerland. App. filed Aug. 15, 1925.

1,641,256. ELECTROMAGNETIC RELAY; J. Erickson, Chicago, Ill. App. filed Dec. 31, 1919. Having a variable time constant adjustable between wide limits.

1,641,264. ELECTRIC SWITCH; A. C. Gaynor and E. G. Gaynor, Stratford, Conn. App. filed April 23, 1924. Spring action; quick make and break.

1,641,265. INSULATING INCLOSURE; A. C. Gaynor, Stratford, Conn. App. filed April 23, 1924. For housing switches, connecting sockets for plugs and other electric apparatus of similar nature.

1,641,270. TRANSFORMER BUSHING SUPPORT; S. Horelick, Pittsburgh, Pa. App. filed April 29, 1922.

1,641,271. TRANSFORMER-TAP CHANGER; S. Horelick, Pittsburgh, Pa. App. filed Feb. 12, 1923.

1,641,272. TRANSFORMER WINDING; S. Horelick, Pittsburgh, Pa. App. filed Dec. 20, 1923.

1,641,277. TWO-WAY SOCKET; W. Ile, Jackson, Mich. App. filed May 9, 1925.

1,641,278. AUTOMATIC ALARM; J. W. Johnson, Auckland, New Zealand. App. filed Aug. 13, 1925. Can be built into articles or containers.

1,641,294. TAP CHANGER; C. A. Roberts, Pittsburgh, Pa. App. filed Aug. 3, 1925. For changing tap connections of oil-immersed transformers from outside the containing tank.

1,641,308. CABINET FOR ARC LAMP; J. H. Wagenhorst, Jackson, Mich. App. filed March 4, 1926.

1,641,353. ELECTRICAL HAIR WAVING AND CURLING DEVICE; R. L. Opper and J. M. Opper, Omaha, Neb. App. filed Sept. 20, 1926.

1,641,359. DYNAMO-ELECTRIC MACHINE; H. M. Stoller, Mountain Lakes, N. J. App. filed May 31, 1922. Single-phase rotary converter which, if desired, may be self-starting.

1,641,368. ELECTRIC PULSATOR; A. B. Arney, McClure, Ohio. App. filed April 28, 1922. A highly sensitive instrument by means of which variations in a very weak current may be utilized to control motion and thus actuate recording, indicating or other devices.

1,641,379. STORAGE-BATTERY SEPARATOR; W. T. Foley, Cincinnati, Ohio. App. filed Feb. 20, 1925.

1,641,386. BATTERY-CHARGING SYSTEM; J. H. Hunt, Dayton, Ohio. App. filed Aug. 3, 1925. Comprising a generator driven at variable speed.

1,641,432. SYSTEM FOR DETERMINING THE DIRECTION OF PROPAGATION OF WAVE ENERGY; F. A. Hubbard, West Englewood, N. J. App. filed Jan. 4, 1921.

1,641,465. INCANDESCENT ELECTRIC BULB; F. L. Weiss, Bronx, N. Y. App. filed Feb. 23, 1926. Having a plurality of filaments so as to be capable of use for various degrees of illumination.

1,641,491. RHEOSTAT FOR LIQUID LEVEL INDICATORS; C. Hyland, Leeds, England. App. filed Oct. 24, 1922.

1,641,524. DRY CELL; C. G. Birdsall, Elmhurst, N. Y. App. filed March 14, 1924. Form in which the depolarizing mixture may be put up.

1,641,532. WATER HEATER; T. P. Cronin, St. Louis, Mo. App. filed Dec. 29, 1924. In which metallic electrodes are designed to be immersed in water, the water surrounding these electrodes serving the purpose of a resistance element.

1,641,548. ELECTRIC MOTOR; A. E. Oswald, Hackensack, N. J. App. filed April 13, 1925. Universal fractional-horsepower type.

1,641,564. ELECTRORESPONSIVE CELL; C. H. Zierdt, Rosedale, Allegheny County, Pa. App. filed Dec. 14, 1922. Thermosensitive cells.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, fruther information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

An agency is desired in Yarmouth, Canada (No. 27,215), for storage batteries for radios and automobiles.

An agency is desired in Sydney, Australia (No. 27,213), for household electrical appliances, electrical accessories, batteries, fittings and power-house equipment.

An agency is desired in Derby, England (No. 27,263), for electrical appliances.

An agency is desired in Prague, Czechoslovakia (No. 27,211), for filaments for the manufacture of radio tubes.

An agency is desired in London, England, (No. 27,216), for household electrical appliances, especially vacuum cleaners and electric refrigerators.

An agency is desired in Milan, Italy (No. 27,220), for insulating materials and porcelain insulators.

Purchase is desired in Durban, South Africa (No. 27,210), of small electrical laundry machinery.

An agency is desired in Hamburg, Germany (No. 27,212), for radiotechnical and electrotechnical articles and novelties.

Purchase is desired in Asperg, Germany, (No. 27,262), of electric refrigerators.

Purchase is desired in Lisbon, Portugal (No. 27,264), of signs and electrical equipmention for motion pictures and theaters.

An agency is desired in Milan, Italy (No. 27,214), for switchboards and accessories, lighting and wiring materials, and dry cells.

An agency is desired in Durban, South Africa (No. 27,119), for electrical appliances.

An agency is desired in Paris, France (No. 27,125), for electrical appliances.

Purchase is desired in Quebec, Canada (No. 27,120), of electrical fittings and fixtures for public buildings.

An agency is desired in Manchester, England (No. 27,124), for electric motor appliances.

An agency is desired in Madras, India (No. 27,123), for ceiling and table fans.

An agency is desired in Hamburg, Germany (No. 27,156), for household electrical appliances.

Purchase is desired in Curaçoa, West Indies (No. 27,118), of lighting equipment for theaters.

An agency is desired in Durban, South Africa (No. 27,121), for electric ranges.

Purchase is desired in Shanghai, China (No. 27,301), of electric horse clipping machines.

Purchase is desired in Pforzheim, Germany (No. 27,360), of electric furnaces.

Purchase and agency are desired in Hamburg, Germany (No. 27,333), for electrical household appliances.

Purchase or agency is desired in Hamburg, Germany (No. 27,334), for electrical household appliances.

An agency is desired in Prague, Czechoslovakia (No. 27,339), for insulating materials.

New Trade Literature

DIESEL ENGINE.—Bulletin No. S-173 issued by the Worthington Pump & Machinery Corporation, 115 Broadway, New York City, describes the Worthington double-acting, two-cycle Diesel engine. The various parts of the engine are well illustrated and described.

HEATING UNITS. — Bulletin C-109 issued by the Edwin L. Wiegand Company, 422 First Avenue, Pittsburgh, describes and illustrates its "Chromalox" heating units for domestic and commercial ranges and hotel and restaurant kitchen equipment.

STARTING RHEOSTATS. — Bulletin GEA-59 issued by the General Electric Company, Schenectady, N. Y., describes and illustrates its "CR-1003" inclosed, heavy-duty starting rheostats for direct-current motors.

CRANES.—Bulletin No. 43-X issued by the Harnischfeger Corporation, Milwaukee, describes and illustrates the "P. & H." corduroy cranes.

ASH CONVEYER.—The Conveyer Corporation of America, 326 West Madison Street, Chicago, has issued a catalog entitled "American steam-jet ash conveyer." This catalog describes the latest refinements of design in this conveyer and illustrates the fittings and equipment necessary for complete installations. It also contains a number of installation photographs and diagrams on the method of application to various types of boilers.

STREET LIGHTING AND THE CENTRAL STATION.—Special publication 1762 issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., shows the part street lighting plays in civic and community life, what highway, and street lighting contributes in the way of safety, prosperity and comfort, and why the electric service company should give street lighting the same promotion effort that it bestows on domestic appliances and residence lighting.

CONTROL APPARATUS.—Several bulletins and price sheets issued by the Allen-Bradley Company, Milwaukee, cover its electric control apparatus and supersede similar publications of earlier dates.

ELECTRICAL EQUIPMENT — Bulletin No. 110 issued by the Pyle-National Company, 1334 North Kostner Avenue, Chicago, covers railway and industrial electric equipment. It contains descriptions and illustrations of locomotive turbo-generators, turbo-generators for train control, locomotive headlights, train-lighting system, yard floodlights and towers, industrial floodlights, industrial turbo-generators and Oliver appliances for locomotive, car, shop and industrial wiring.

REVERSING MOTORS.—The Reliance Electric & Engineering Company, 1053 Ivanhoe Road, Cleveland, has issued bulletin No. 1064, which describes and illustrates its reversing motor drive.

GEARED TURBO-GENERATORS — Leaflet No. 20,293 issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., describes its geared turbo-generator units from 75 kw. to 500 kw. for alternating- and direct-current operation. A number of photographs showing the construction of these units are included.

SPEED REDUCER.—The Link Belt Company, 910 South Michigan Avenue, Chicago, has issued bulletin No. 715, describing and illustrating the "Link-Belt" Sykes herringbone speed reducer.

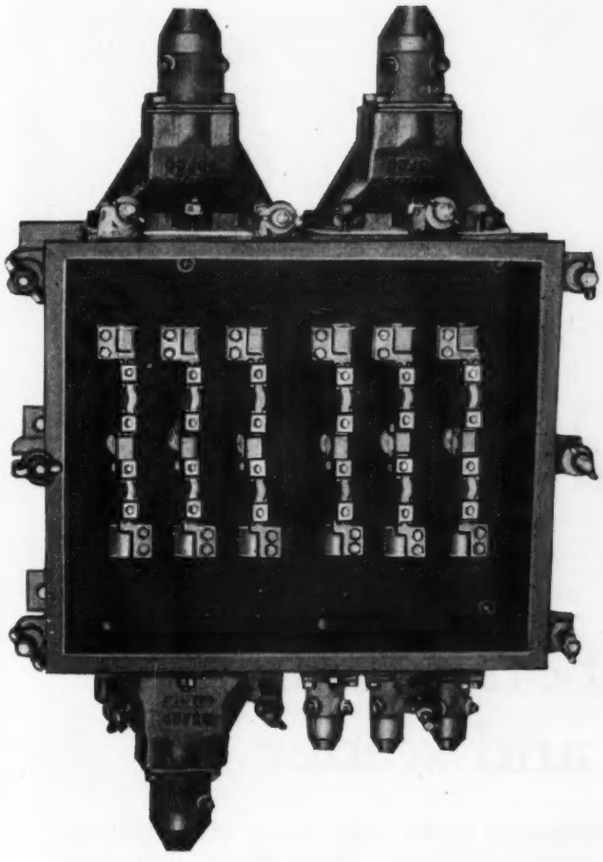
REGULATORS FOR GAS PRODUCERS. —The Chowning Regulator Corporation, Corning, N. Y., has issued a bulletin which describes and illustrates a recent development of a step-by-step controller and electric shut-off attachment for the Chowning gas-producer regulator.

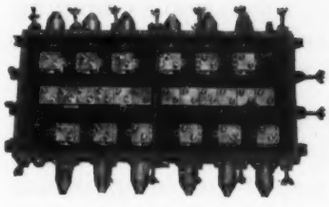
NICKEL-CAST IRON.—A bulletin, No. 203, entitled "The Economic Value of Nickel in Cast Iron," has been issued by the International Nickel Company, Inc., 67 Wall Street, New York. The company is also distributing bulletin No. 204, entitled "Effect of Nickel on Machinability of Cast Iron." The bulletins describe the outstanding improvements in alloy cast iron and its economic importance to foundryman, machinist and the ultimate consumer.

SPEED CONTROLLER.—Bulletin GEA-360A issued by the General Electric Company, Schenectady, N. Y., describes and illustrates the remote-indicating speed controller, "type CR7761-F1," for alternating-current slip-ring induction motors.

TYPE "F" BOXES

A Means of Sectionalizing Your Low Tension Secondary System





Precedent, with this organization, doesn't count—continual improvement does. The organization and perfection of distribution equipment has been our constant aim. We have always advanced new equipment. Economy and improved service has always been the result for power companies using G & W equipment.

The G & W unit plan of construction in these 250 and 600 volt boxes, will appeal to the engineer who demands flexibility. Cable arrangements, link fuses, various ampere ratings, future additions, and finally, the actual operation of the box, are the flexibility features in the G & W design. Ease of installation and permanence are regular G & W characteristics.

The unit plan idea also makes the cable entrances interchangeable. Using single conductor or multiple conductor cables does not disturb the internal arrangement of the box. A 3-conductor cable head will fit the same side opening as three single conductor entrances.

The boxes are thoroughly immersion-proof. Between the lid and the box is a heavy rubber gasket and a 5 lb. air test guards against breathing through pores in the iron. The cable insulation terminates under compound in the cable head, preventing any moisture entrance.

G & W Electric Specialty Co.
7780 Dante Ave., Chicago, Ill.

EXACTLY WHAT YOU WANT

G & W designs and manufactures practically every device for the end of a cable.

See our Catalog No. 26.

Oil and air break disconnecting devices.

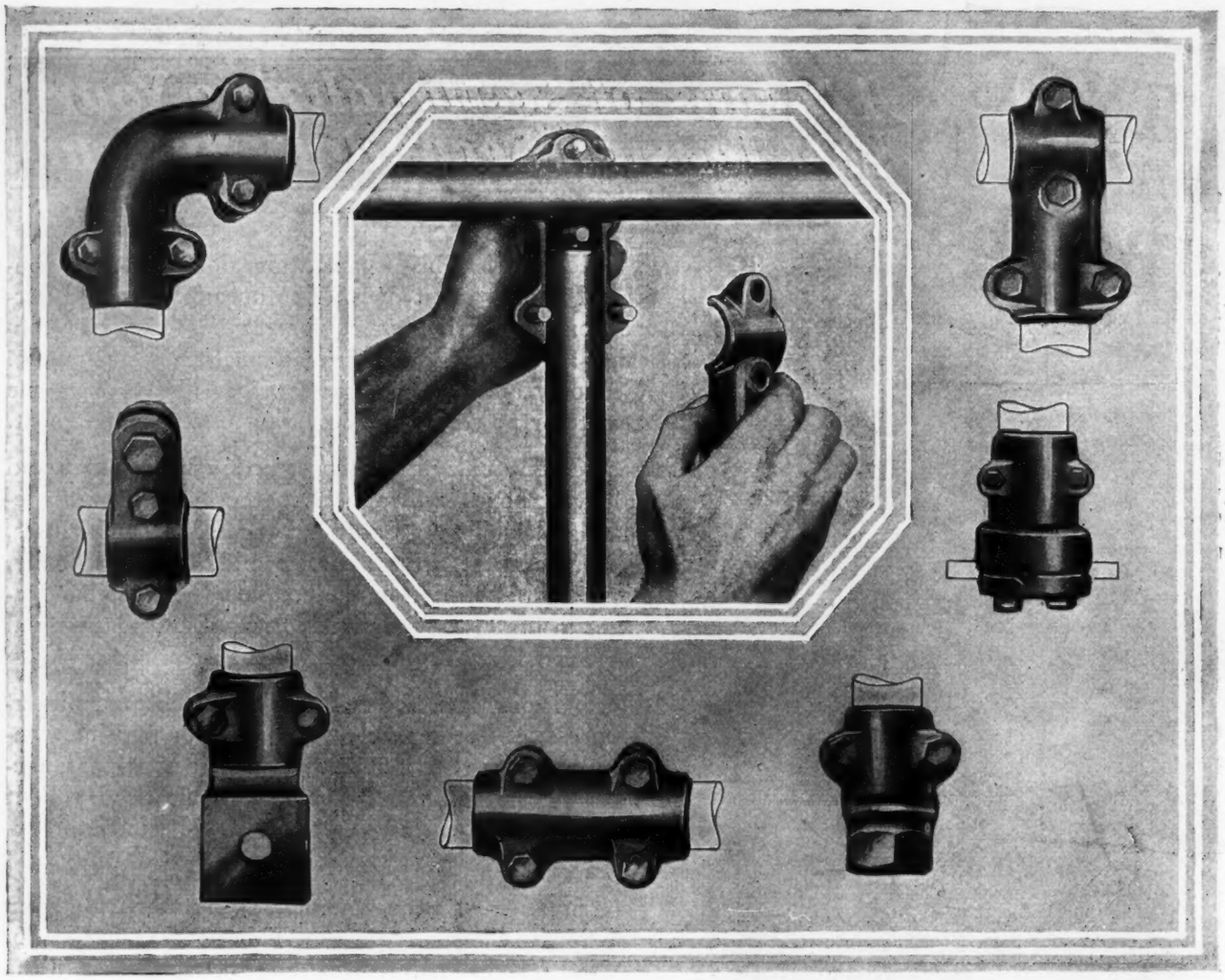
Transformer vault units with or without automatic control. Oil disconnecting potheads.

Potheads
Series Cutouts
Primary Cutouts
Oil Fuse Cutouts
Underground Boxes
Conduit Bells
Ground Caps
Ground Pipe Points

Send for Vault Unit Bulletin

More than Protection **G&W** for the Cable Ends

POTHEADS AND BOXES



Clamp your outdoor-station buses — *don't* cut, fit, and solder

These clamp connectors make easy work of installing outdoor-station bus structures. With them you can make any tubular bus connection by a simple clamping operation. In addition to the standard connectors, a wide range of special fittings is available.

The clamps are made of copper alloy for I.P.S. copper tubing or galvanized iron pipe. Four to eight hot-dip galvanized bolts, depending on the size of the clamp, insure good contact, correct alignment, and rigid construction.

Let us send you a descriptive sheet giving sizes and dimensions of the complete line. Just ask our nearest sales office for a copy of GEA-286A.

Outdoor Station Equipment

—part of the complete line of General Electric equipment to control and protect power-generating and distributing apparatus.

500-13

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

BALANCED

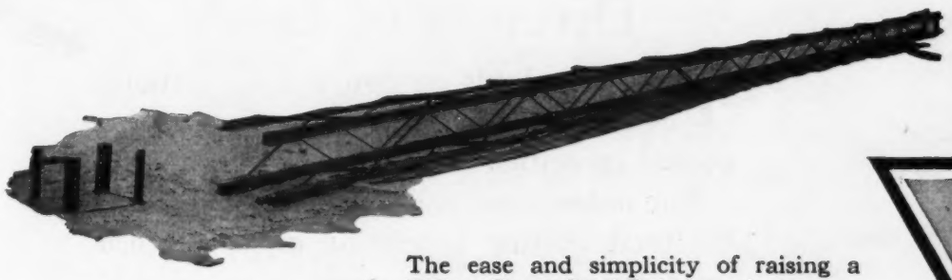
STRENGTH-DESIGN-MATERIAL APPEARANCE — PRODUCTION

PAGE 7

4 TYPES

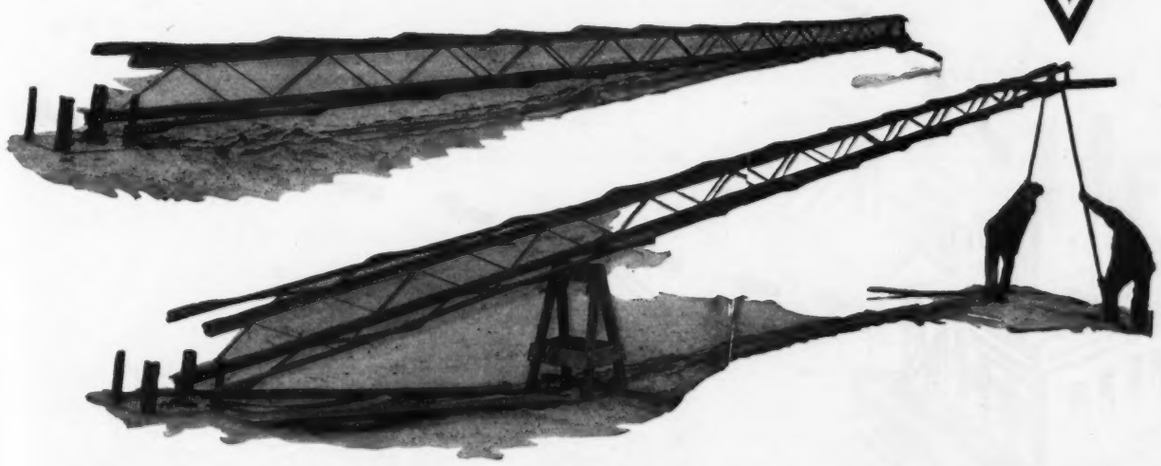
Simple to erect

The greater economy of Walter Bates Steel Poles begins with the pole erection and continues on thru the pole service because of their balanced features. Made up to 60 ft. in height—up to 45 ft. without splices.



The ease and simplicity of raising a Walter Bates Steel Pole is an important feature. The pole at top shows one of these poles in place, ready to bolt to stubs. The picture below shows pole bolted to stubs, the bolts acting as a hinge. The pole is next seen being raised —no trouble or lost time.

STEEL
POLES
TOWERS
SUBSTATIONS
FLOOR GRATING
and other Steel Products for Utilities



WALTER BATES STEEL CORPORATION

GARY INDIANA

CLEVELAND, O.
E. S. Stickle Company
342 Rockefeller Bldg.

DALLAS, TEXAS
Jack Milburn
908 Allen Bldg.

BIRMINGHAM, ALA.
Shook & Fletcher Supply Co., Inc.
827 Brown-Marx Bldg.

ATLANTA, GA.
E. A. Thornwell
Candler Bldg.

EXPORT REPRESENTATIVE
Wonham Bates & Goode Trading Corp.
44 Whitehall St., New York City

BUFFALO, N. Y.
E. S. Stickle Company
40 West Seneca St.

Inter Connection

Its effect on

(Case 13)

Diversity of Loads

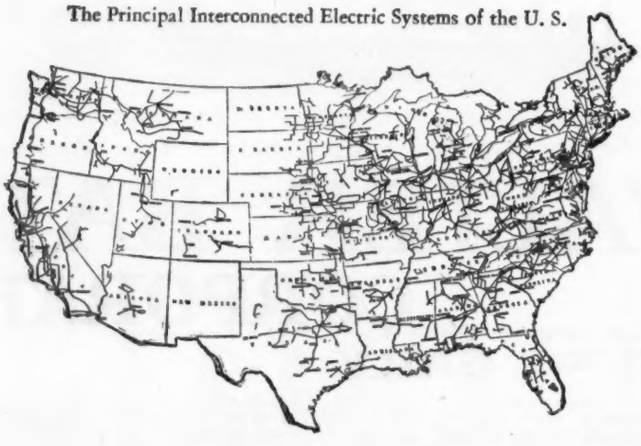
THE peak loads on two isolated stations, considered individually, may demand increased capacities.

But unless these peaks coincide as to time, the total existing generating capacity when interconnected may be ample to serve both.

Serving the peak is a topic very close to the heart of utility management.

Discussed in terms of interconnection this brings to light some interesting possibilities.

The Principal Interconnected Electric Systems of the U. S.



A Practical Instance

From "*Getting Down to Cases in Electric Interconnection*"
—*by* BONBRIGHT & CO., INC.

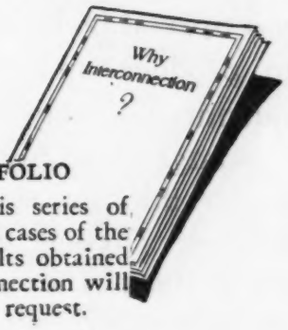
A net saving of $515,000 in investment and an additional 2,000 kilowatts of capacity made available

IN OKLAHOMA three medium sized stations—the first 4,200-kilowatt, the second 1,000-kilowatt, and the third 1000-kilowatt—all needed additional capacity to take care of load demands in their immediate territory, and at the same time provide sufficient emergency reserve.

Good engineering dictated a 5,000-kilowatt unit in the first plant, a 1,000-kilowatt unit in the second, and a 1,000-kilowatt unit in the third. This would have cost about $875,000 for the 7,000 kilowatts.

The peak loads came at different times on these three plants. By tying them together with a transmission line the resulting composite load curve made it possible for the system as a whole to take on an additional load of 2,000 kilowatts, still leaving ample provision for emergency reserve.

The cost of this interconnection, 90 miles, was $360,000.



A PORTFOLIO

presenting this series of fifteen definite cases of the economic results obtained from interconnection will be sent on request.

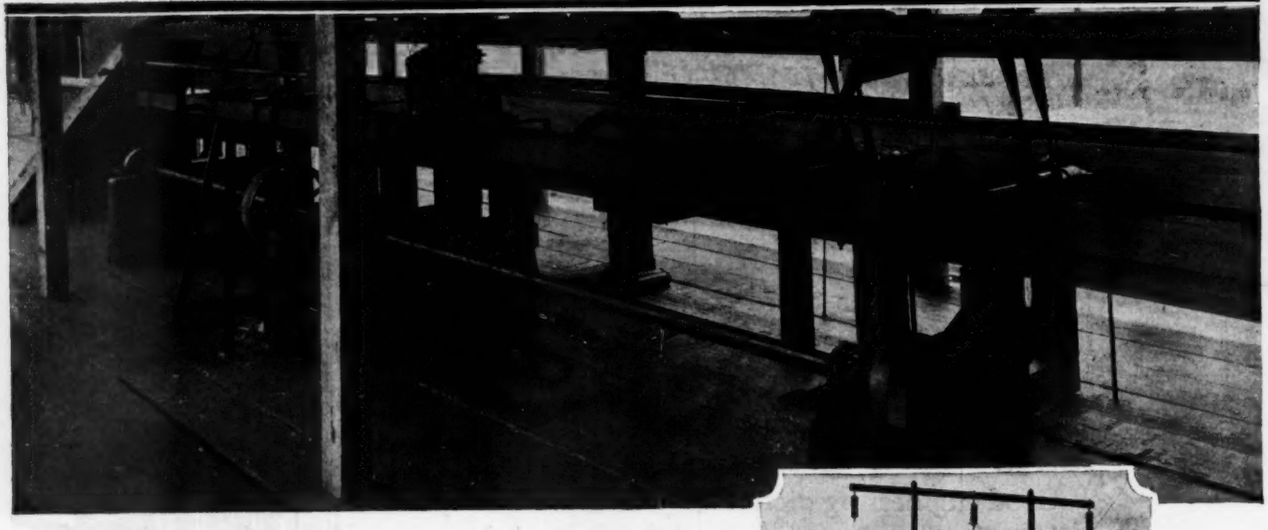
"No interconnection can be a success unless the attitude of the respective companies and their operating forces is based upon a mutual consideration of the interests of both companies in the service of the public."
POWER SURVEY COMMITTEE
Dec. 1, 1925 Great Lakes Division, N. E. L. A.

OHIO BRASS COMPANY, MANSFIELD, OHIO

Believing interconnection stands out among the factors that have enabled Electric Light and Power Companies to keep down the price of electricity in the face of higher costs of the elements entering into its production, the Ohio Brass Company presents this serial portrayal of how interconnection is assisting in

Giving the Public Better Electric Service

Super-Service on Creosoted H-Frame Cross Arms—



When you need cross arms—*short or long, large or small*—just wire us. Special facilities enable this Organization to produce and ship on short notice any quantity you may desire.

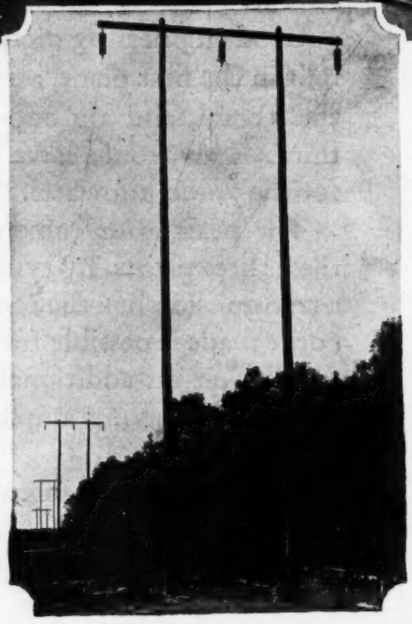
A large stock of cross arm timber is kept on our yards at the plant, and a big sawmill is our next-door neighbor. Dressing, framing and boring are done at one handling. The highly-efficient machine pictured above bores all necessary holes in 5¾ x 7¾, 30 ft. H-frame type arms at one time; and the capacity of our modern, high-pressure plant is ample to take care of emergency orders.

Quotations promptly furnished.

Texas Creosoting Company

Main Office and Plant: Orange, Tex., U. S. A.

"BLACK BEAUTY" CROSS ARMS

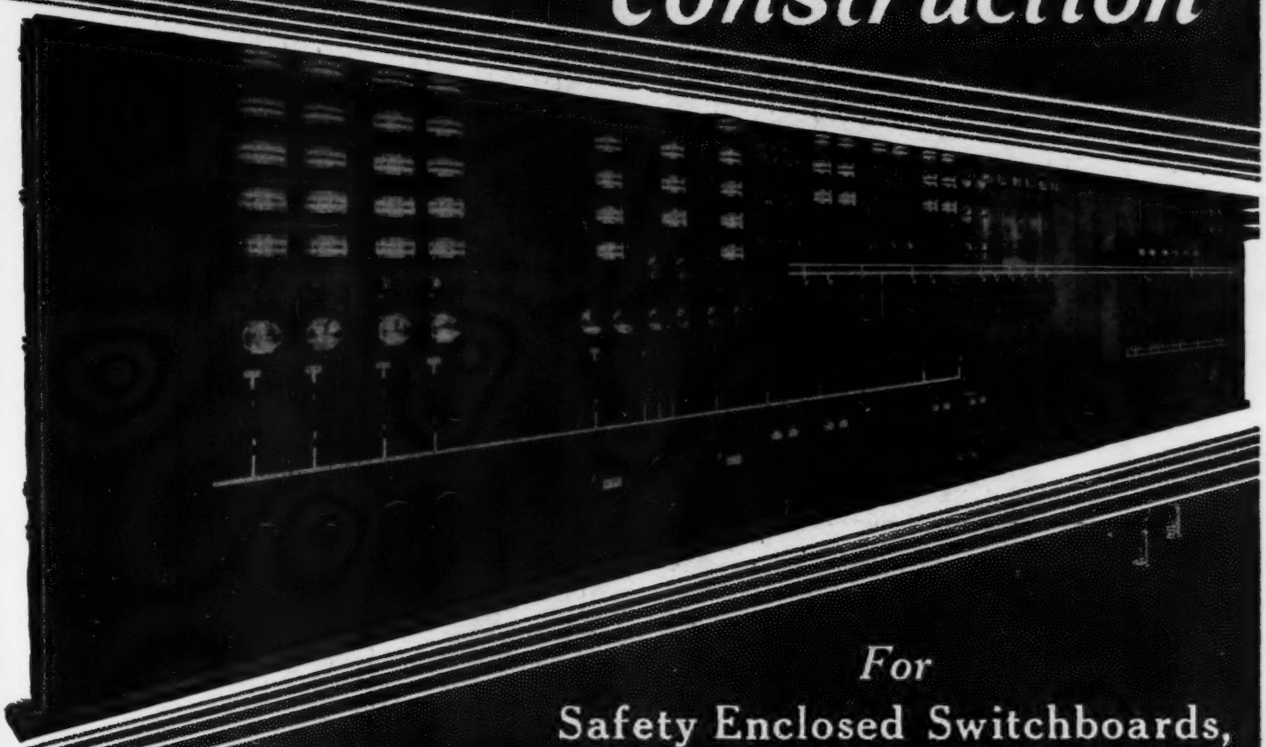


500, 29 ft. Arms Shipped on 48 Hours' Notice

At 8.25 a.m., April 30th, we received a wire from the West Texas Utilities Company, asking for immediate shipment of 500—5¾" x 7¾", 29-ft. Cross Arms to Flat Rock, Texas, specially framed as per blueprint we had on file.

These arms were framed; treated full length by the vacuum-pressure method; loaded; and the 4 cars left our plant the following morning, accompanied by a special messenger to see that no time was lost in making connections and arriving at destination.

The last word in switchboard construction



For
Safety Enclosed Switchboards,
Removable Truck Type, Bench Board, Automatic
Electrical and Manual Controlled Switchboards.

"Get in touch with Condit"

CONDIT ELECTRICAL MFG. CORP.
Manufacturers of Electrical Protective Devices
Boston, Mass.

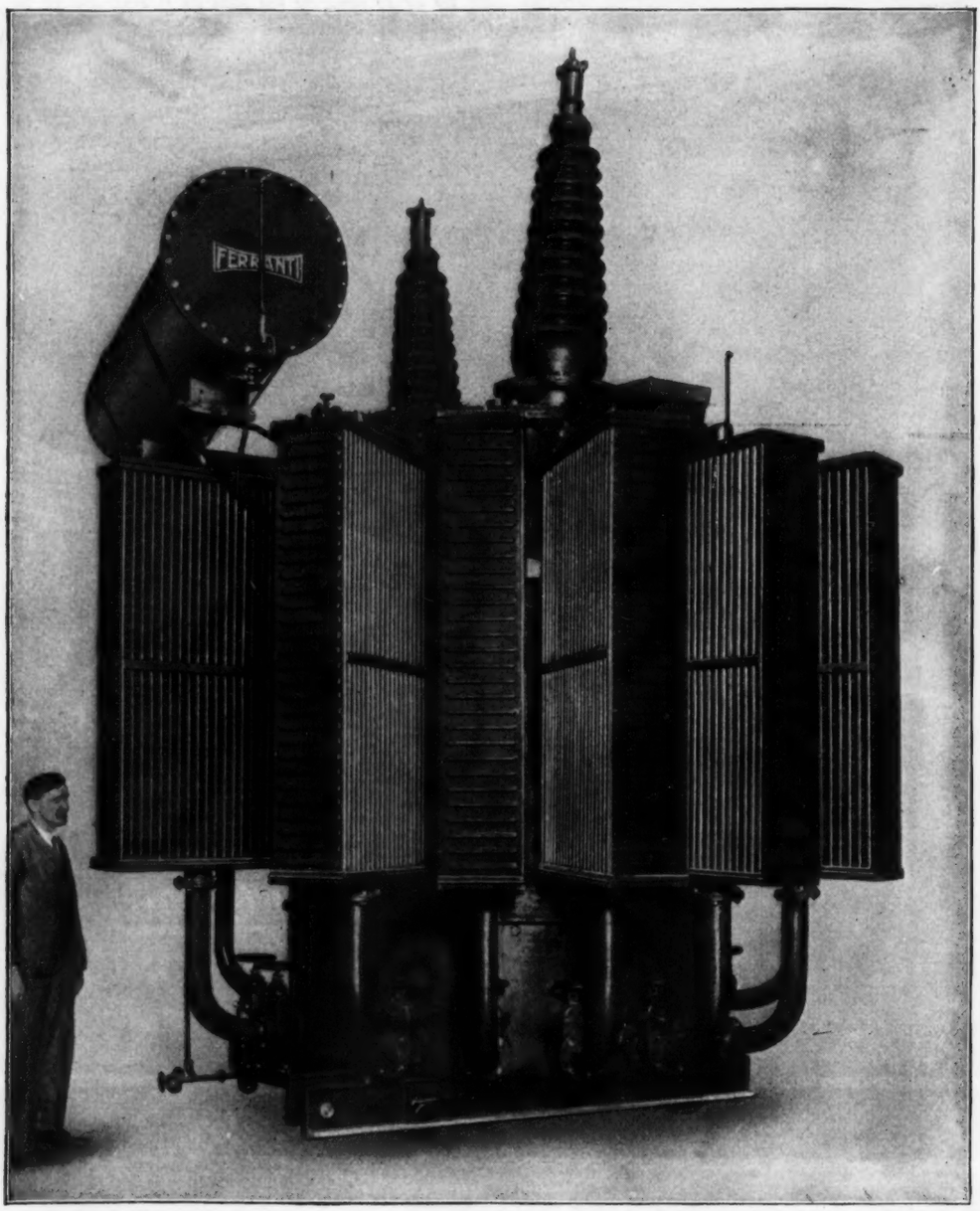
Northern Electric Company LIMITED Sole Distributor for the Dominion of Canada

CONDIT

A 5,000 K.V.A. RADIATOR TYPE

FERRANTI TRANSFORMER

for 110,000 Volts Transmission

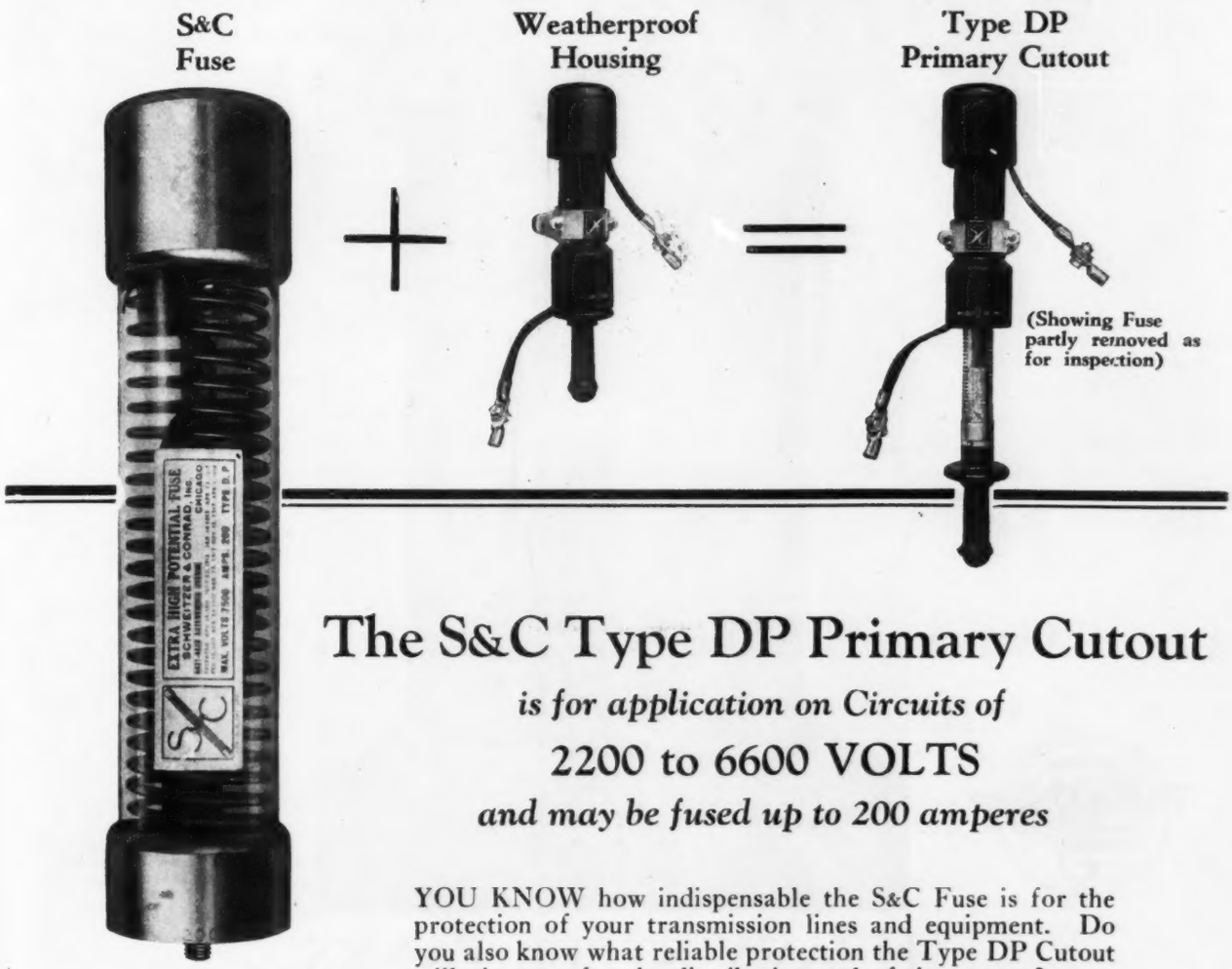


FERRANTI, INC.
130 W. 42ND STREET
NEW YORK

FERRANTI, LTD.
HOLLINWOOD
ENGLAND

FERRANTI ELECTRIC
LIMITED
TORONTO, CANADA

Formula for Reliable Protection of Large Distribution Transformers



The S&C Type DP Primary Cutout

is for application on Circuits of

2200 to 6600 VOLTS

and may be fused up to 200 amperes

YOU KNOW how indispensable the S&C Fuse is for the protection of your transmission lines and equipment. Do you also know what reliable protection the Type DP Cutout will give you for the distribution end of the system?

This Cutout has an interrupting capacity of 10,000 amperes, yet occupies a space on the cross arm of only 5 in. x 5 in. x 21 in.

It is a Cutout having the well known dependability of the S&C Fuse combined with an insulating housing and the utmost convenience for changing of fuses. Besides, it makes possible a most economical and fine appearing installation.

Ask for Bulletin 201.

Makers of the S&C High Potential Fuse

SCHWEITZER S&C CONRAD, INC.

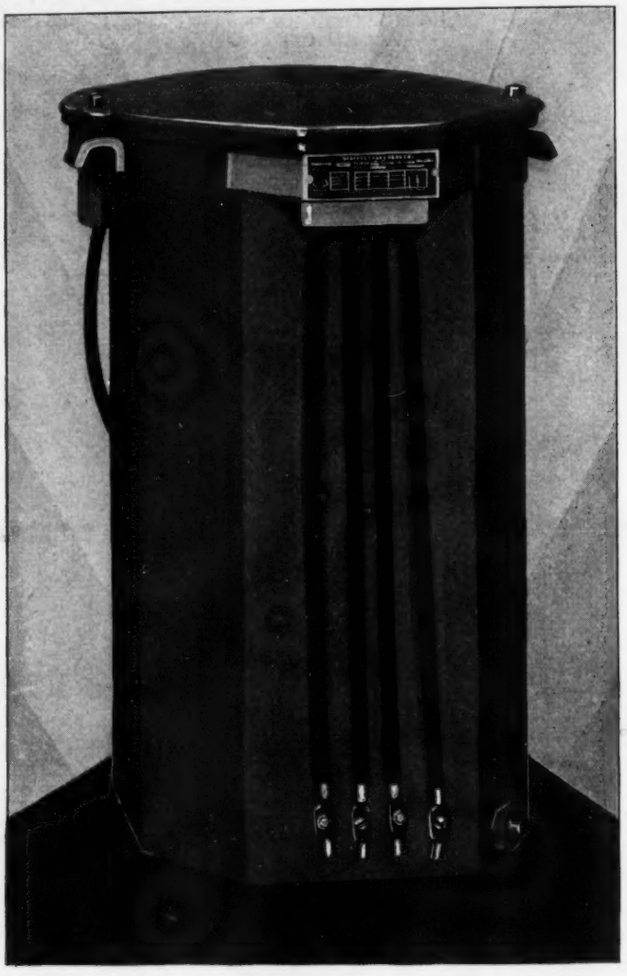
4435 RAVENSWOOD AVENUE CHICAGO, ILLINOIS, U.S.A.

New York, Boston, Philadelphia — Buffalo, Pittsburgh, Birmingham — Detroit, Cleveland — St. Louis, Minneapolis — Kansas City, Omaha, Dallas — Seattle, Los Angeles, San Francisco

Japan, T. Hasegawa Co., Osaka

PRODUCTS

MOTORS—Single, Polyphase and Fynn-Weichsel Motors TRANSFORMERS—Power, distribution and instrument FANS—Desks, Wall and Ceiling types



Style of sheet steel case with plain high-voltage bushings, for ratings of from 1½ to 37½ kva. inclusive.

HEAVY STEEL TANKS

—the better to withstand rough handling, rust and corrosion.

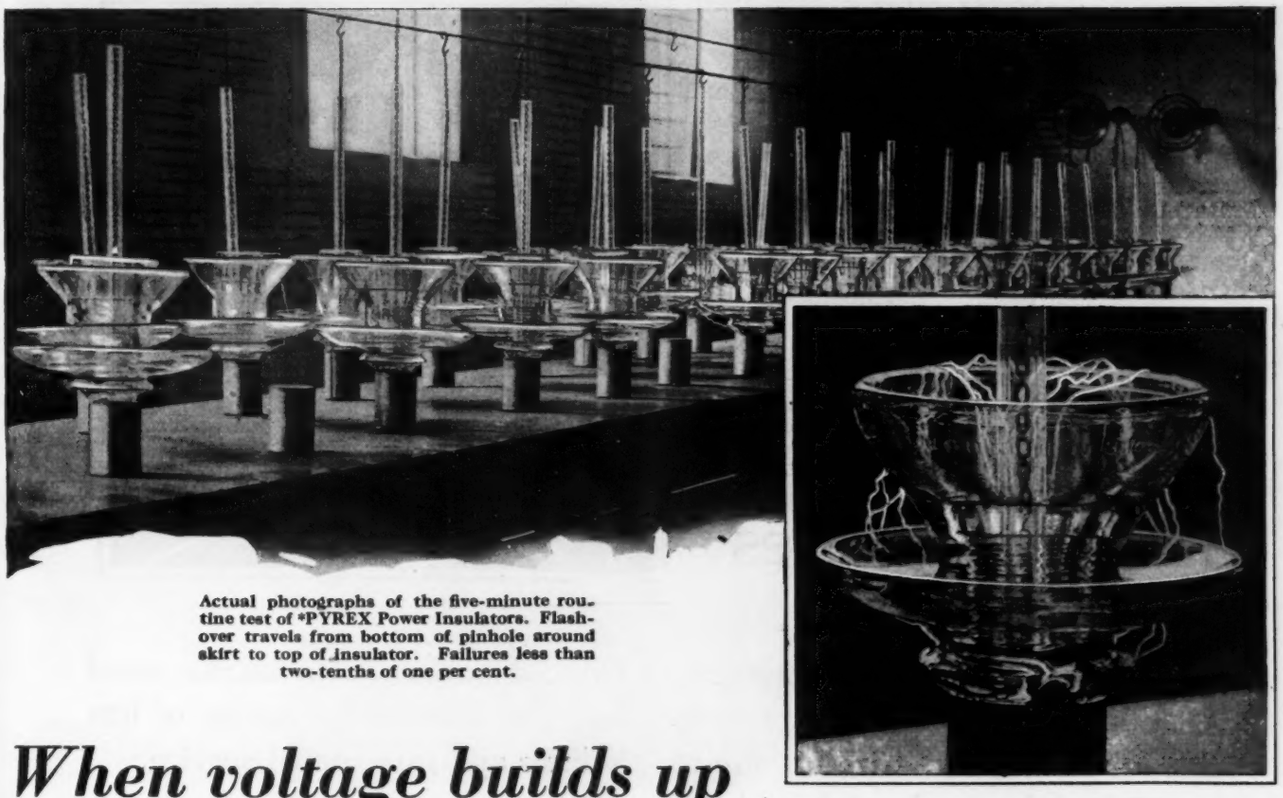
The Tanks of all Wagner Distribution Transformers are of heavy gage steel, electrically welded, either plain, with radiating tubes or corrugated depending upon the rating. The great mechanical strength of these Tanks is a protection against damage in handling and erection.

Copper-bearing sheet steel is the material used for Tanks of Wagner Transformers up to and including 100 kv-a., 13,800 volts. This type of steel affords maximum resistance against rust and corrosion. You can't go wrong if you put your trust in Wagner Distribution Transformers.

Ask for Bulletin 148

6737-6

WAGNER ELECTRIC CORPORATION—6400 Plymouth Avenue—St. Louis, U.S.A.



Actual photographs of the five-minute routine test of *PYREX Power Insulators. Flash-over travels from bottom of pinhole around skirt to top of insulator. Failures less than two-tenths of one per cent.

When voltage builds up

. . are you *sure* your insulators will flash-over . . not puncture?

EVERY *PYREX Transmission Insulator is subjected as a complete unit to a *five-minute* flash-over test at a voltage, depending upon the humidity, from 25 to 50 per cent greater than the voltage used in the usual routine table test.

This excess voltage is built up by increasing the length of the path which the discharge must travel. Each insulator is inverted upon a metal pedestal. The electrode to the bottom of the pinhole is encased in a glass tube. The flash travels from the bottom of the pinhole around the skirt to the top of the insulator.

*Trade-mark Reg. U. S. Pat. Off.

Yet in this rigid over-potential test, *less than two-tenths of one per cent* of PYREX Power Insulators fail!

This remarkable uniformity in performance of PYREX Power Insulators, plus their 25 to 50 per cent higher flash-over test voltage, is proof that with them no unseen weakness can threaten the service of your line. PYREX Power Insulators will flash-over—not puncture.

Ask our nearest sales office to demonstrate the unusual qualities of these new power insulators to you.

A complete catalog will be sent upon request.

PYREX

T. M. Reg. U. S. Pat. Off.

POWER INSULATORS

A PRODUCT OF CORNING GLASS WORKS

369 Lexington Avenue, *New York, N. Y.*

SALES OFFICES

79 Milk Street, *Boston, Mass.*

211 I. W. Hellman Bldg., *Los Angeles, Calif.*

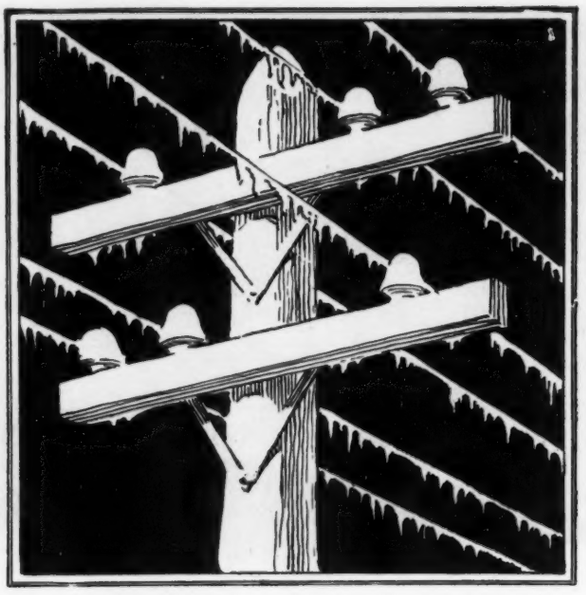
193 Second Street, *San Francisco, Calif.*

Candler Building, *Atlanta, Ga.*

Polson Building, *Seattle, Wash.*

3152 Cambridge Ave., *Chicago, Ill.*

HITENSO "BB" Wire Reduces the Risk of Failures in Rural Lines



HITENSO "BB" is a high strength, high conductivity wire suitable for long spans. Size for size it has 77% of the conductivity of hard drawn copper, and 30% greater strength. Compared with hard drawn copper of equivalent conductance, it has 60% greater strength. Hitenso "BB" has the same density, modulus of elasticity and temperature coefficient of expansion as copper.

Because of its combination of high conductivity and great strength, Hitenso "BB" Wire of small diameter may be used for long spans. The reduced surface exposed to wind and sleet lessens the danger of line failures and interrupted service.

Hitenso "BB" is as easy to handle as copper, and both original construction and extensions can be made with a minimum labor cost. It is highly resistant to abrasion and the effects of arcing.

An Engineering Department is maintained to assist electrical engineers in the design of cables for special conditions. You are invited to make use of this service.

ANACONDA COPPER MINING CO.—THE AMERICAN BRASS COMPANY
Rod, Wire and Cable Products
General Offices: 25 Broadway, New York Chicago Office: 111 W. Washington St.

ANACONDA COPPER
BRASS ANACONDA BRONZE

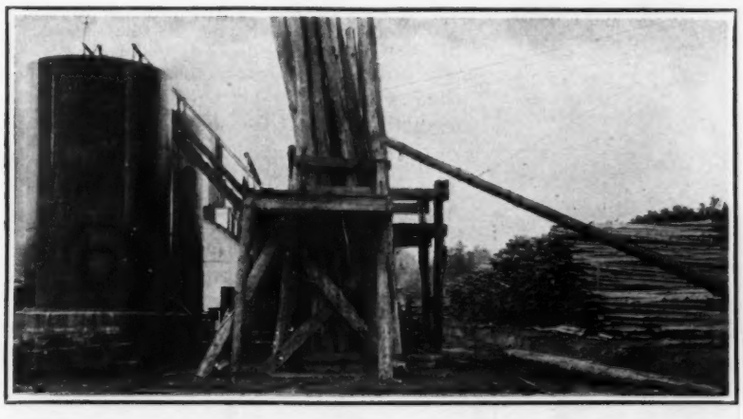
Where the strain is greatest Chestnut *Butt-Treated* Poles

On curves or up and down hill wherever the poles are subjected to severe strains, Chestnut Butt-Treated Poles are superior.

In the early days Chestnut poles were used principally because of their convenient location, but time proved them ideal for hard continuous service.

Today Chestnut Butt-Treated Poles are selected from *southern* forests, sorted, seasoned and treated. They are better than ever.

A typical example of the use of Chestnut Butt-Treated Poles is shown. These poles are carrying 23,000 volts and illustrate dead end construction by an eastern power company. Write for details.



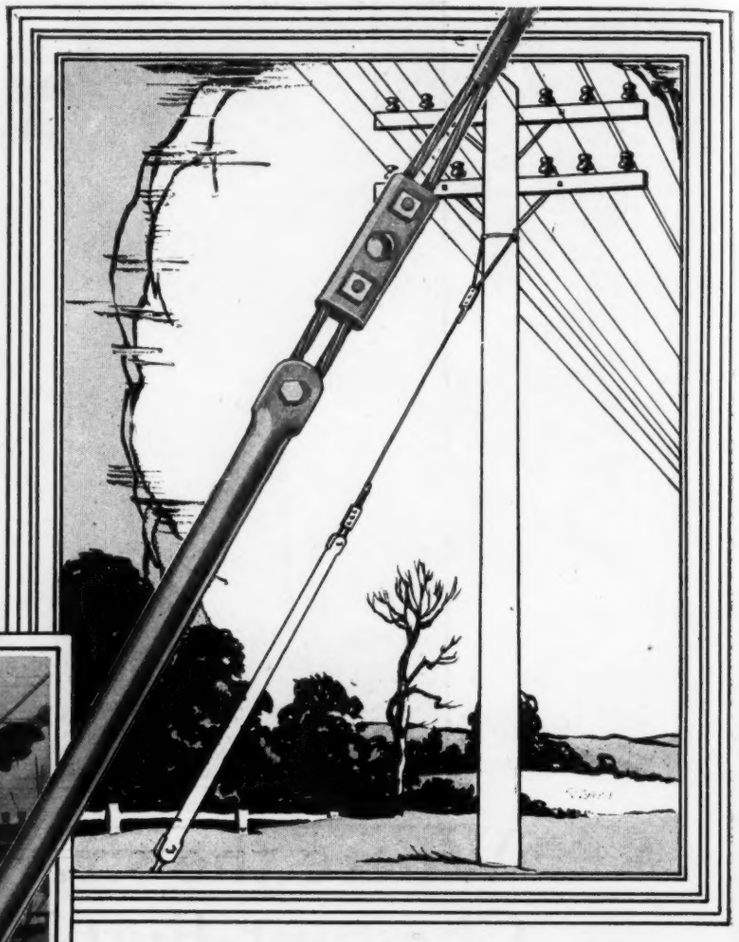
View of Yards at Athens showing tanks in which Poles receive Butt-Treatment.

The Frankfort Lumber Co.

General Offices
16 East Broad St., Columbus, Ohio

Yards and Treating Dept.
Athens, Ohio

Why use *two* articles when *one* will do?



An Actual Test on No. 7568 Guy Guard.

The Guy Guard was pulled up by dynamometer test just below the elastic limit of the Anchor Rod. It was then hit by a heavy duty truck. The wheel on the left was lifted off the ground and the Guard was slightly injured.

No. 7568

HUBBARD GUY GUARD
Combines a Guy and Protector All In One

When you think of it, doesn't it seem absurd to put an extraneous protector on the guy wires when the guy itself can be made more visible and a better protection to the public.

This is the thought which actuated Hubbard Engineers in developing this new Visible Guy and Protector combined.

It saves eight feet of guy strand. It saves fifteen to thirty minutes in labor. It is stronger than the Guy Rod. It is more visible than any ordinary guy protector. It cannot be bent out of shape and become a menace if hit by a passing auto, because the guy strain immediately pulls it back into alignment.

Furnished in eight-foot lengths, of two different weights of steel. The No. 7568 Guy Guard has 65% more strength than a 5/8-inch Anchor Rod, while the No. 7569 Guy Guard has 50% more strength than a 1-inch Anchor Rod.

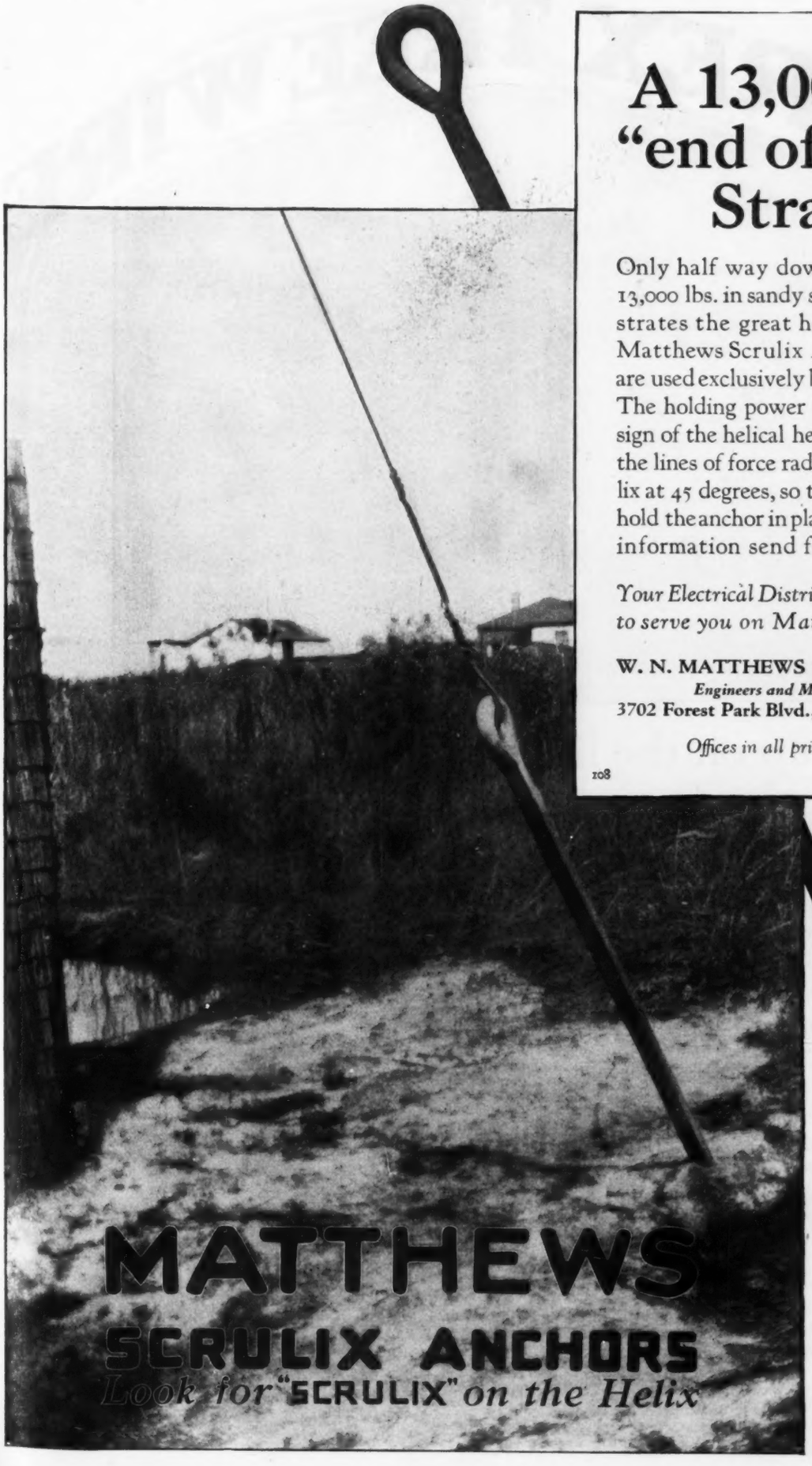
Investigate this new means of saving money and improving your construction.

These guy guards are carried in stock and sold exclusively by the leading electrical jobbers.

HUBBARD

Hubbard and COMPANY

PITTSBURGH ⁂ OAKLAND, CAL. ⁂ CHICAGO



A 13,000 lb. "end of line" Strain

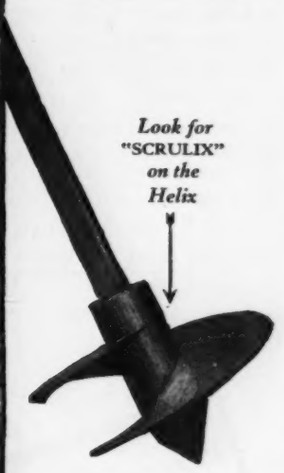
Only half way down and holding 13,000 lbs. in sandy soil. This demonstrates the great holding power of Matthews Scrulix Anchors, which are used exclusively by this company. The holding power is due to the design of the helical head. Under strain the lines of force radiate from the helix at 45 degrees, so that tons of earth hold the anchor in place. For complete information send for Bulletin 802.

Your Electrical Distributer will be glad to serve you on Matthews Products.

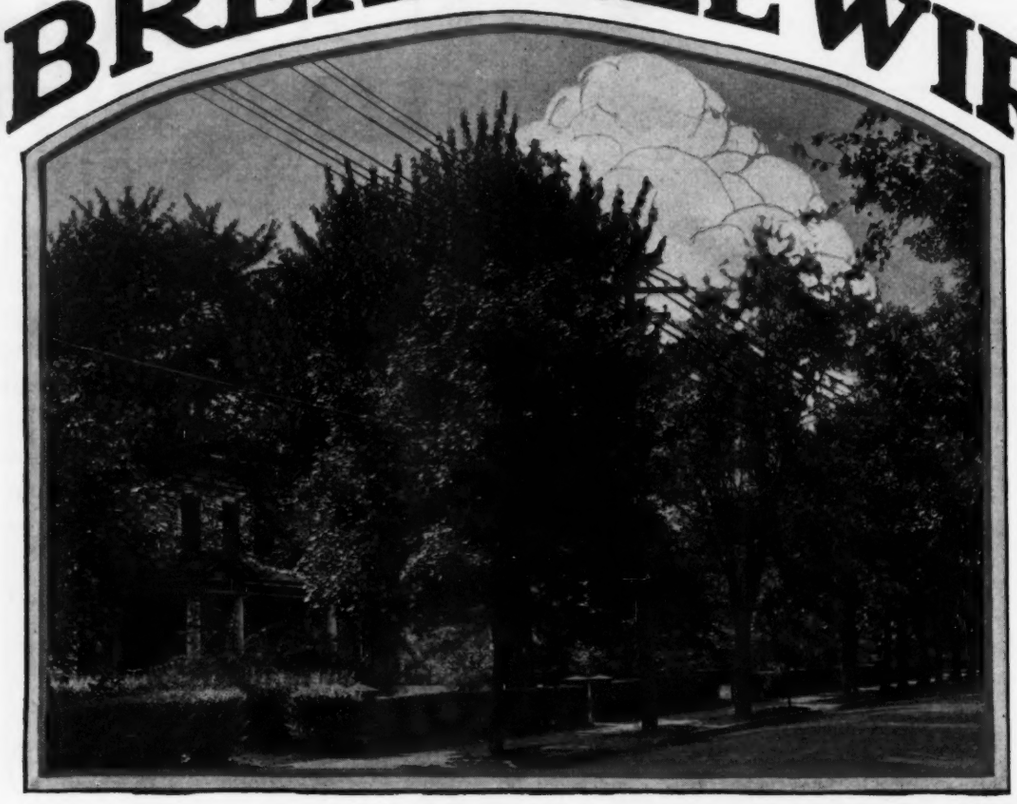
W. N. MATTHEWS CORPORATION
Engineers and Manufacturers
3702 Forest Park Blvd., St. Louis, U. S. A.

Offices in all principal cities

108



FIBREX TREE WIRE



Check up on the lines before winter comes!

There is still time to go over the lines and find where bare wires rub on the limbs of trees. A systematic checkup of places where trouble threatens and the splicing in of Fibrex Tree Wire will enable you to maintain line voltage and to give continuous service through the long winter months.

Fibrex Tree Wire is non-inductive. It will not rot. It cannot rust. It prevents arcing, short circuits and leakage. It is the best protection against abrasion. Ozone proof. It has been in use 16 years and the original installation is still in service.

Fibrex is used principally in wooded places and through trees that cannot be trimmed. Here as in countless other places—Fibrex Tree Wire has been tested and proved. It wears like steel tape yet has none of its disadvantages.

Fibrex will pay for its cost many times over, meanwhile maintaining uniform line voltage and giving continuous service. It is made for all commercial voltages.

Get a sample and examine it. Sent promptly on request.

SIMPLEX WIRE & CABLE Co

MANUFACTURERS

201 DEVONSHIRE ST., BOSTON

New York Chicago San Francisco Cleveland Jacksonville

Simplex Wire & Cable Co.,
201 Devonshire St., Boston, Mass.

Gentlemen:—

Please send me the Simplex Manual. ☐

Please send sample, price and quotation on Fibrex. ☐

Size..... No. of Conductors.....

Voltage..... Feet.....

Name .....

Position .....

Company .....

Address .....

City .....

State .....

A 570 ft. span

"Service is the thing"

This "H" Frame Span across a reservoir near Oskaloosa, Iowa, consists of 65 foot Carney Western Red Cedar Poles.

All of the poles used in this line erected by the Hoosier Engineering Co., for the Iowa Southern Utilities Co., are Carney Class "A," and butt treated half-inch Pentrex.

B. J. CARNEY & CO.

Main Offices

100 North 7th St., Minneapolis
Sicamous, B. C.
Enderby, B. C.
Peyton Bldg., Spokane, Wash.

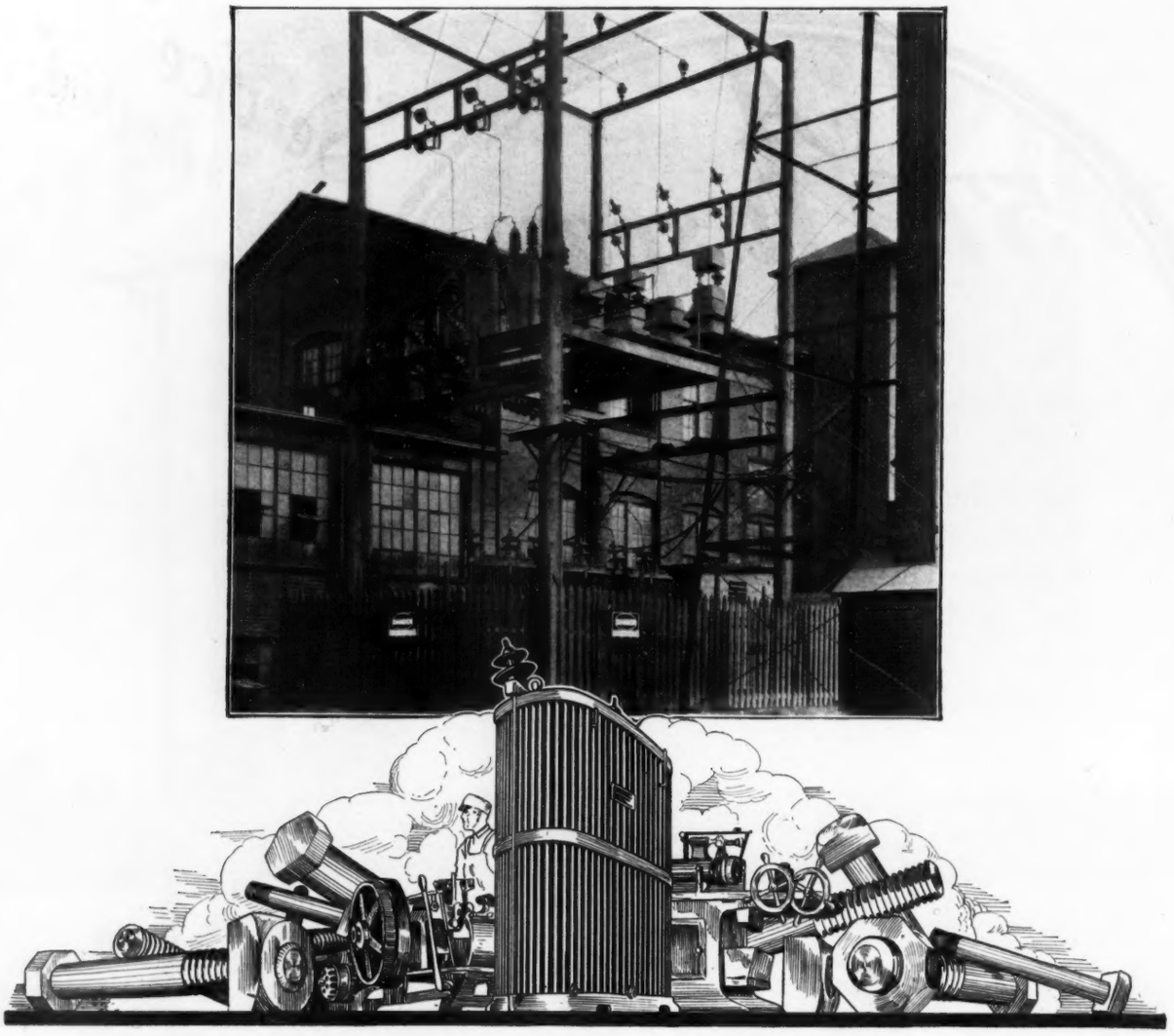
Treating Plants

Minneapolis
Sand Point
Spokane

General Sales Offices

435 Commercial Tr. Bldg., Philadelphia
115 So. Dearborn St., Chicago
214 Old South Bldg., Boston
905 2nd Nat'l Bank Bldg., Cincinnati, Ohio
839 Oliver Bldg., Pittsburgh

PENTREX guarantees ⅜ or ½ inch penetration on every pole.



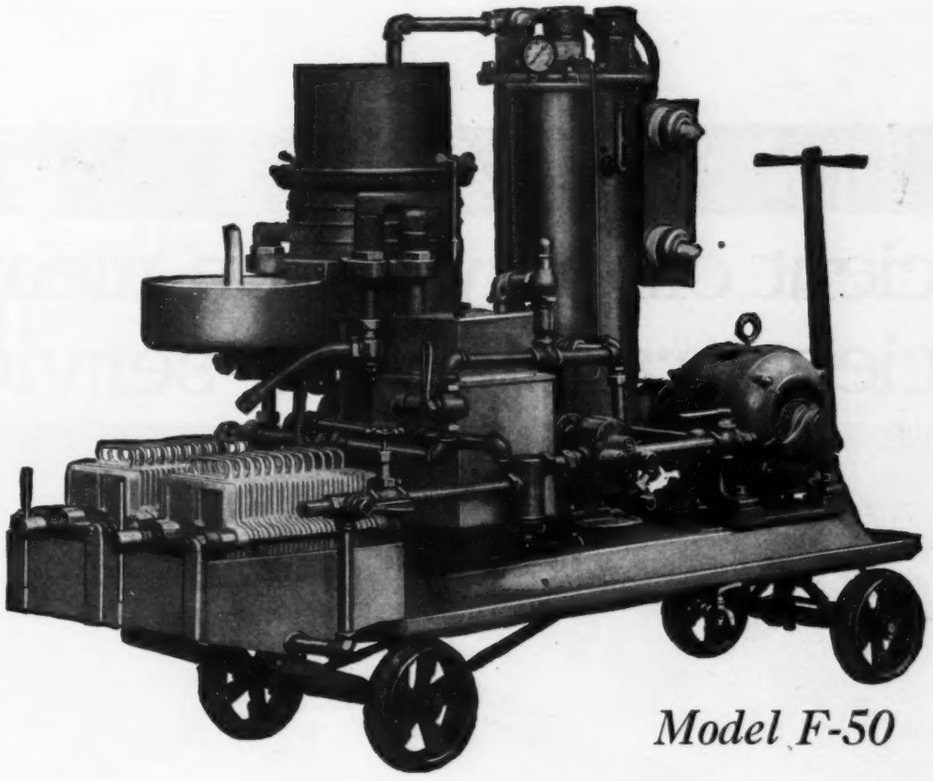
Bringing In Power Through Packard

The Lamson & Sessions Company took special precautions to insure the continuity of their power supply at their modern Kent, Ohio, factory. Every feature of this installation is up to the minute and among other things they placed reliance on "Honest Value" which they know to be built into Packard Transformers.

Where continuity of power and freedom from shutdown is of prime importance, Packard Transformers are bound to prove a profitable investment. You will find us represented by capable engineers in all of the larger cities.

The Packard Electric Company Warren, Ohio

Packard
TRADE MARK
is never seen, except on goods of honest value



Model F-50

SWITCH AND BREAKER OIL ECONOMICALLY CONDITIONED

THE HYDROIL oil purifying equipment is complete

No extra pumps, piping, motors, switch boxes, heaters, or filter required. All these necessities are provided in the HYDROIL and it is portable.

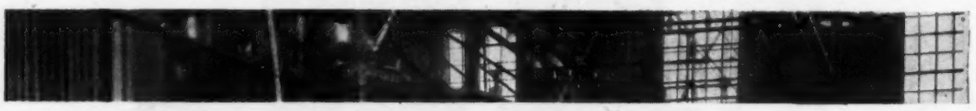
Ability—One passage through the HYDROIL bowl will remove all water, sludge, acid, etc. from the oil. One passage through the filter will remove all carbon. The air eliminating device will remove all the air.

Oil delivered from the HYDROIL can be immediately passed through our Continuous Testing Chamber, and will show a dielectric strength of above 22,000 volts on this continuous test.

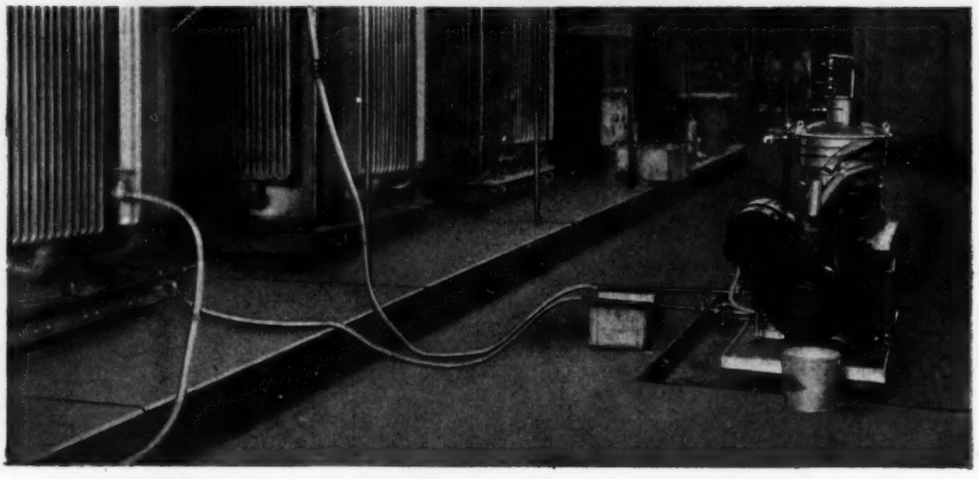
Economy—The HYDROIL bowl is self-cleaning. It can be taken apart, cleaned, and reassembled in less than ten minutes. The dual filter press makes it possible to change the filter papers while the machine is operating. It is portable and no special attention required to set or level the machine.

Quality—The best of material is used in the construction of the HYDROIL. Base, gear housing, cast iron. Heater casing, collecting pans, intake funnels, aluminum castings. Spindles, pumps, gears, and shafts are heat treated steel, hardened and ground. The HYDROIL is equipped throughout with standard dimension precision ball bearings.

Hydroil
SALES CORPORATION
LEBANON, INDIANA



Efficient oil dehydration means efficient transformer service



De Laval Transformer Oil Purifier at work in a substation of Chester Valley Electric Company, Coatesville, Pa.

THE first requirement of transformer and circuit breaker oil purifying apparatus is that it effects a thorough removal of impurities. After that *speed* is essential.

De Laval centrifugal purification easily leads in meeting these two conditions—it is the most positive oil conditioning method known, adding to ordinary centrifugal purification the tremendous advantage of the patented De Laval system of strata distribution, which improves the effectiveness of purification and increases the *actual* hourly capacity of the machine.

That is why De Laval Purifiers are used by 80% of the largest electric power systems in America.

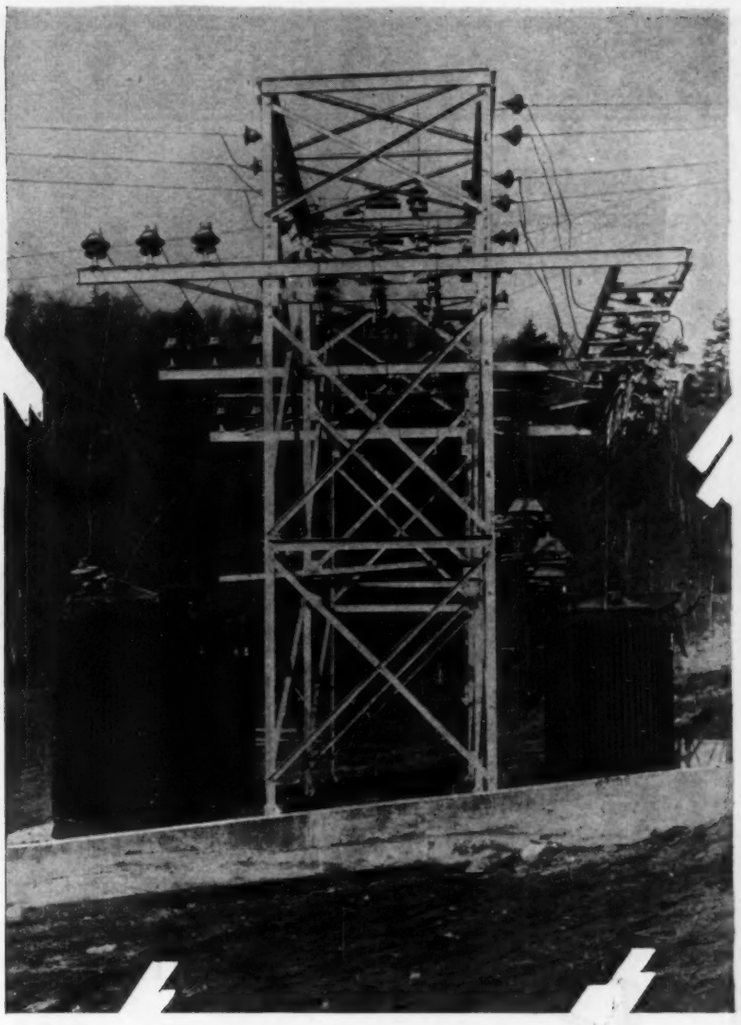
The De Laval engineering department will be glad to cooperate with you in order that your transformer oil and switch oil may give the same kind of service that keeps these great systems and hundreds of smaller ones running so smoothly. In writing for further information please ask particularly for Bulletin 107-W.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 600 Jackson Blvd., Chicago
DE LAVAL PACIFIC COMPANY, San Francisco
ALFA-LAVAL CO., Ltd., 34 Grosvenor Road, London, S. W. 1.

De Laval Oil Purifiers

Types for Lubricating Oil, Fuel Oil, Transformer and Circuit Breaker Oil, Crankcase Oil

Another Kuhlman Installation



Kuhlman Transformers having a capacity of 2400 Kva. installed at Hardwick, Vermont.

The fact being emphasized by this installation series is simply that Kuhlman Transformers are day after day doing their work well in central stations, sub-stations, industrial plants, theatres, railroads, and a host of other special fields.

Each installation is additional testimony to the complete reliability and high operating efficiency of Kuhlman Transformers.

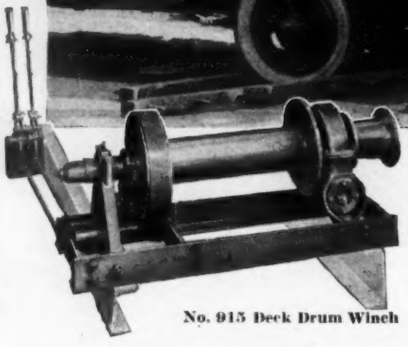
KUHLMAN TRANSFORMERS

KUHLMAN ELECTRIC CO., Bay City, Michigan

Akron	High and Barges Sts.	Dallas	Unit 2, Santa Fe Bldg.	Minneapolis	1004 Marquette Ave.	Saint Paul	1479 Blair St.
Atlanta	411 Glenn Bldg.	Denver	1843 Wazee St.	Montreal	415 Canada Cement Bldg.	Salt Lake City	134 West 2d South St.
Boston	69-71 High St.	Detroit	3-260 Gen. Motors Bldg.	New York	Graybar Bldg.	San Francisco	Call Bldg.
Buffalo	280 Carolina St.	Greensboro, N. C.	333 S. Davie St.	Oklahoma City	1013 Braniff Bldg.	Seattle	314 Seneca St.
Chicago	844 Rush St.	Indianapolis	202 Indiana Ter. Whse.	Omaha	923 W. O. W. Bldg.	Toledo	424 Spitzer Bldg.
Cincinnati	1308 Union Trust Bldg.	Los Angeles	316 American Bank Bldg.	Philadelphia	1700 Walnut St.	Washington	1328 New York Ave.
Cleveland	627 Union Trust Bldg.	Milwaukee	1031 Clybourn St.	Pittsburgh	839 Oliver Bldg.	York, Pa.	335 W. Market St.

MEAD-MORRISON

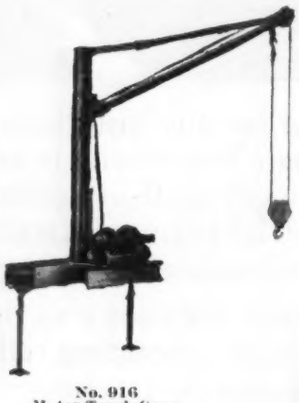
Setting a Concrete Pole Mount with a Mead-Morrison Pole Derrick and No. 915 Winch.



No. 915 Deck Drum Winch

No. 901 Capstan Winch

A Winch for Every Purpose



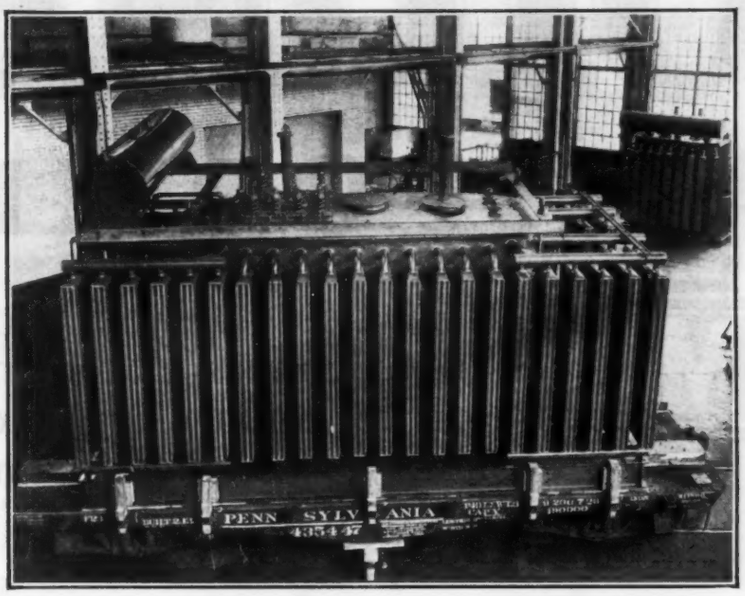
No. 916
Motor Truck Crane

The Mead-Morrison
Pole Derrick

Mead-Morrison Motor Truck Winches, Cranes and Pole Derrick meet every Utility requirement. For handling poles, pulling cables, loading and unloading transformers, pipes, pole mounts, reels, etc., Mead-Morrison Winches are unbeatable. Every Utility operating Mead-Morrison Winches tells the same story —less time wasted, fewer men, greater economy. More work accomplished. Greater satisfaction all around. Write for Catalog 28 showing the complete line.

MEAD-MORRISON
MANUFACTURING COMPANY
926 Prescott St. Boston, Mass.
Distributors in principal cities

HOISTING - HAULING - HANDLING



New York & Queens Electric Light & Power Company. 15,000 Kva. Pittsburgh Polyphase Transformer. The Largest Self-Cooled Transformer Shipped Complete by any Manufacturer in the History of the Electrical Industry.

This transformer is rated 15,000 Kva.

In actual size, due to triple winding, it is 22,000 Kva.

This is the largest Self-Cooled transformer ever shipped complete by any manufacturer, full of oil.

No radiators to attach in the field.

No oil to be put in the transformer.

No filtering of oil necessary.

No danger from moisture.

Time and money saved in installation.

Built complete, including tank, base, radiators, etc. (all parts but accessories), in our Manchester Plant.

When you have the specifications ready for your next order for transformers, let us submit proposals on Pittsburgh Transformers.

Pittsburgh Transformer Company

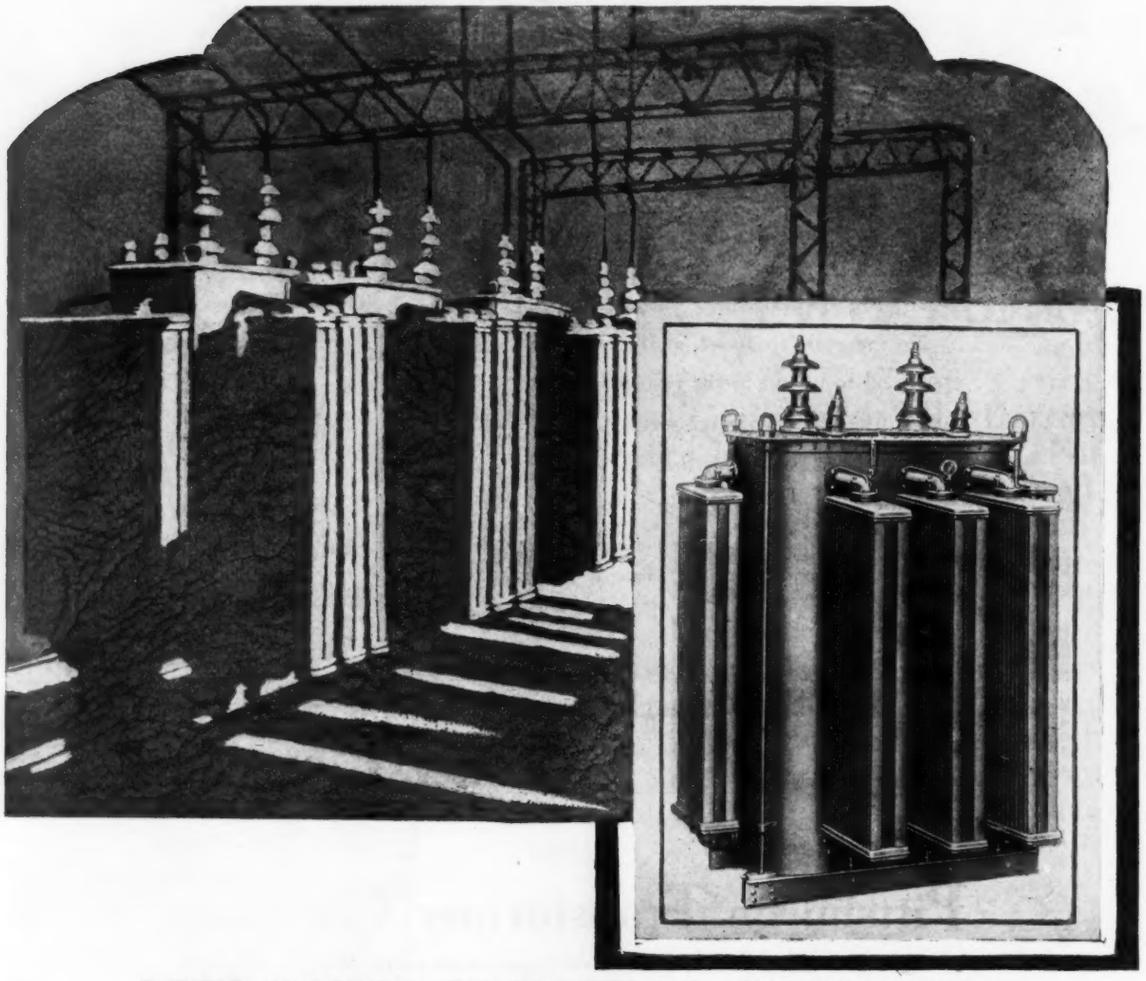
Largest Manufacturers of Transformers exclusively in the United States

Pittsburgh, Pennsylvania

MOLONEY

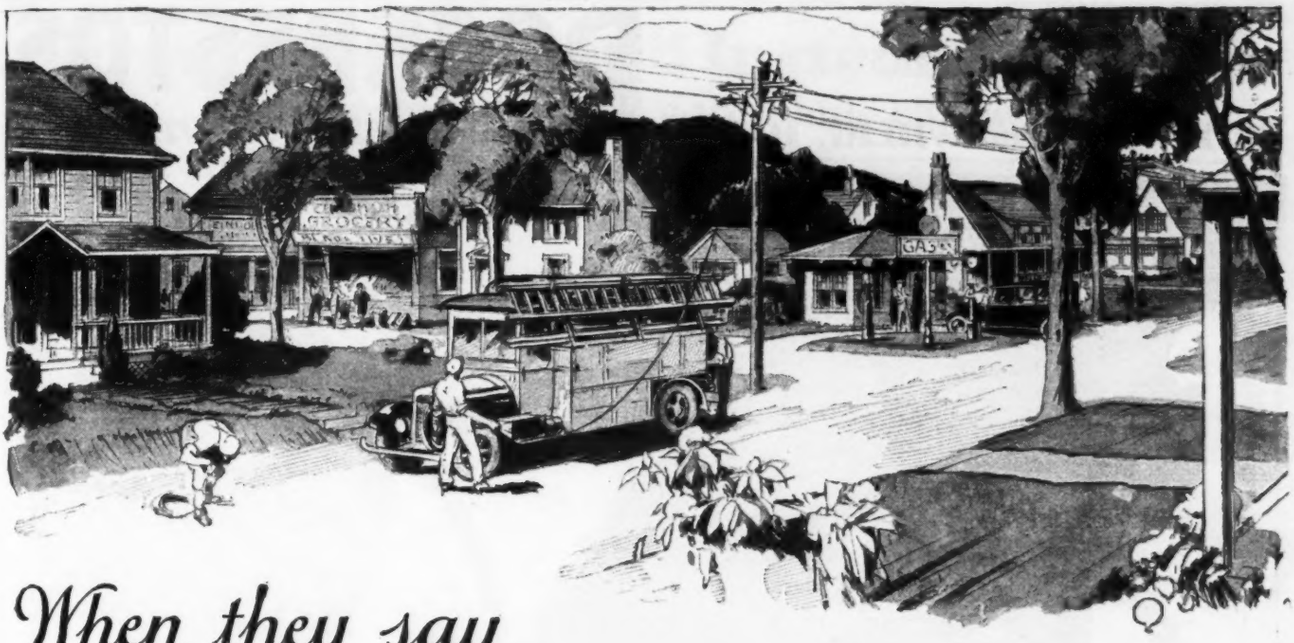
TRANSFORMERS

MOLONEY designs and produces transformers in the interest of dependability and greater economy. We give our undivided attention to Industry's transformer requirements.



MOLONEY ELECTRIC COMPANY

Main Office and Factories: St. Louis, Mo. *Sales Offices in Principal Cities*



When they say

Extend service to this rural community

More substations and more miles of distribution lines will be needed.

Unless the transformers intrusted with delivering this service are ***safe, economical,*** and ***durable***; unless the primary cutouts selected can be "put up and forgotten"; unless the lightning arresters not only furnish ***protection,*** but possess ***long life*** and ***endurance***; unless advantage is taken of the most advanced designs and construction, the service rendered may be impaired.

All G-E Transformer and Accessory Products are offered with full confidence as to the character of their performance. Engineered and built where the required facilities are complete, this G-E line embodies research, experience, and engineering skill.

General Electric's position as a builder of equipment for transmission and distribution is unique. Not only can G-E Transformer Products be supplied for every normal requirement, but a service is available to study any special problem, and, if necessary, develop the equipment required to deliver reliable power in suitable form.

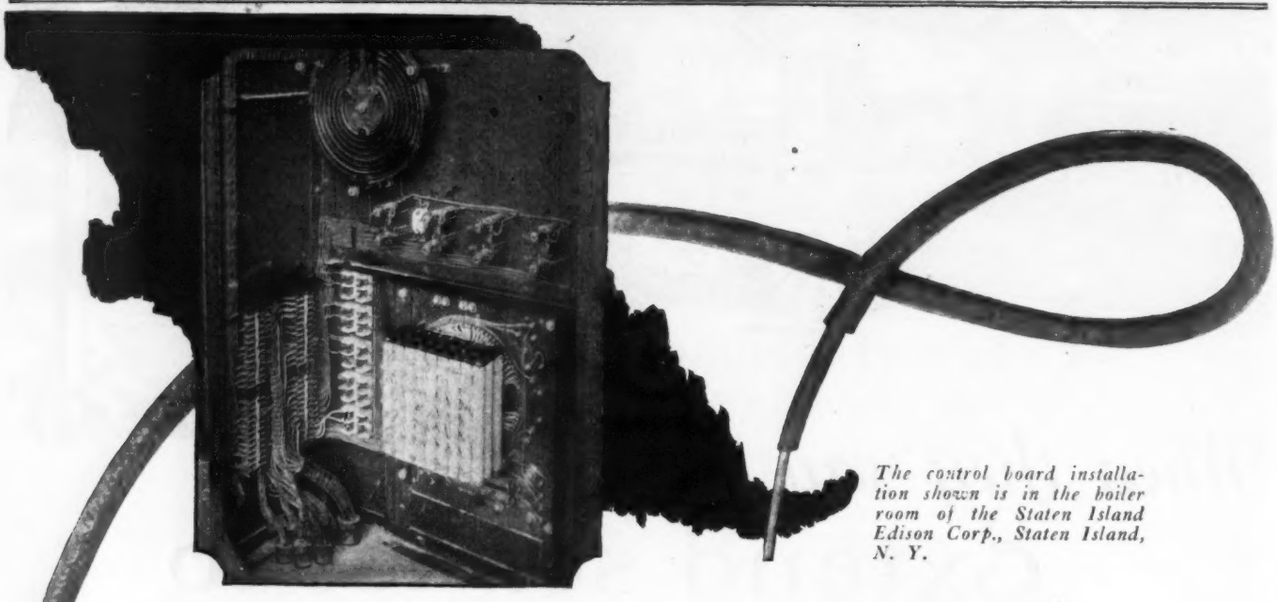
Transformer Products
— the Standards of Quality

401-13

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

WHY, WHEN and WHERE TO USE ROCKBESTOS —the asbestos covered wire



The control board installation shown is in the boiler room of the Staten Island Edison Corp., Staten Island, N. Y.

Example No. 2 For Boiler Room Wiring

The unusual conditions in boiler rooms are ideal for Rockbestos—the asbestos covered wire.—For heat, moisture, flame and fume conditions that are found there.

There are Rockbestos wire and cables built particularly for boiler room service, for lighting circuits, switchboards, controllers, wiring to motors operating high pressure steam valves, etc. Rockbestos wires and cables have already proven practical for boiler room application under operating conditions that are far from ideal, and in some of the largest central stations in the country.

Our engineers have a valuable fund of recent, up-to-date, experience to apply to your problems. Why not consult them now? No obligation of course.

ROCKBESTOS PRODUCTS
CORPORATION
NEW HAVEN, CONN.

5942 Grand Central Term. Bldg., New York 465 Union Trust Bldg., Pittsburgh, Pa. 224 Madison Term. Bldg., Chicago

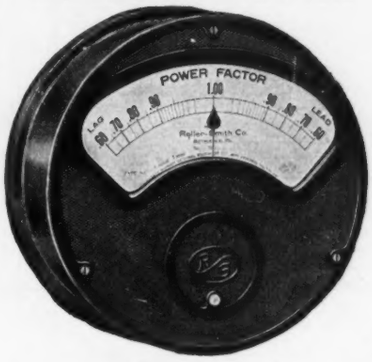
On the Pacific Coast—Allied Industries, Inc.

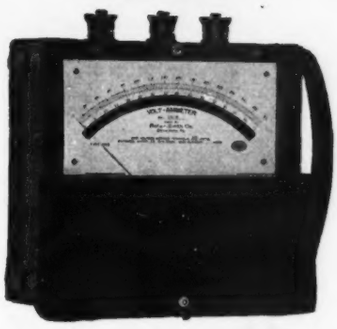
Circuit Breaker and Instrument Data

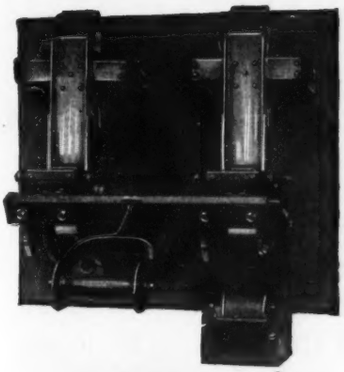
in convenient and get-at-able shape

Just check bulletins desired, fill in name and address, cut out coupon and mail to

A Few of the Many Different Devices made by ROLLER-SMITH







ROLLER-SMITH COMPANY
Electrical Measuring and Protective Apparatus

MAIN OFFICE
237 Broadway, NEW YORK

PUBLICATIONS

ROLLER-SMITH products comprise complete lines of electrical measuring and protective apparatus. Bulletins covering the various devices will be sent promptly upon receipt of coupon.

	Check Bulletins Desired Bulletin No.
SWITCHBOARD INSTRUMENTS	
A. C. Ammeters, Triplex Type, 7½ in. size	D– 30
D. C. Ammeters, Voltmeters and Volt-ammeters, 3½ in. and 4 in. sizes	D–400
A. C. Ammeters, Voltmeters and Wattmeters, 3½ in. and 4 in. sizes	D–420
D. C. Ammeters and Voltmeters, large sizes	D–430
A. C. Ammeters, Voltmeters, Wattmeters, Power Factor Meters, Frequency Meters, Synchroscopes and Ground Detectors, large sizes	D–450
Radio Frequency Ammeters, all sizes	D–810
PORTABLE INSTRUMENTS	
Radio P. V. Voltmeters	D– 40
A. C. and D. C. Volt-ammeters and Ohmmeters for signal system testing	D–100
D. C. Ammeters, Voltmeters and Volt-ammeters, small size	D–110
A. C. Ammeters, Voltmeters and Wattmeters, small size	D–150
A. C. Ammeters, Voltmeters, Wattmeters, Frequency Meters and Power Factor Meters, large size	D–160
Rail Bond Testers	D–200
D. C. Ammeters, Voltmeters, Volt-ammeters and Galvanometers, large sizes	D–210
Precision Torsion Balances for weighing lamp filaments and other small bodies	D–240
Ohmmeters	D–300
INSTRUMENT TRANSFORMERS	
Portable types	D–160
Switchboard types	D–450
CIRCUIT BREAKERS	
A. C. and D. C., Industrial Type, all styles of trips, 100 amperes and less	D–520
A. C. and D. C., Standard Type, all styles of trips, all ampere capacities	D–530
D. C. Relays, reverse current, etc.	D–550
A. C. and D. C., Enclosed Type, 800 amperes and less	D–580
MISCELLANEOUS	
Telephone Receiver Head Sets	D– 20

Name.....

Company.....

Address.....

City..... State.....

Type I-16 Watthour Meter

Accuracy here will be maintained, because—

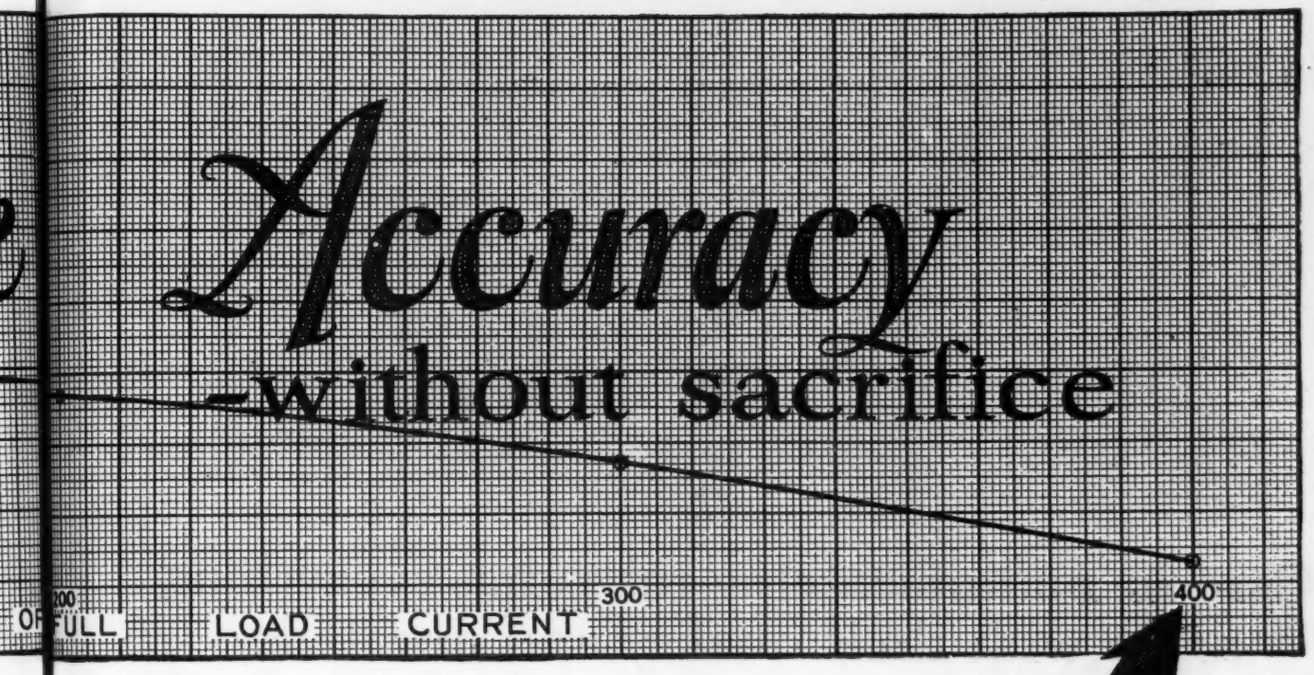
It is not enough for a watthour meter to be accurate on light load when first installed. It must remain so for years without attention so that it will faithfully record the very light loads to which it is subjected.

This sustained light-load accuracy is dependent upon a high torque to overcome the detrimental effect of friction-increase at low loads.

A study of *all* the characteristic curves of the I-16 meter will convince you of its supremacy. You can get these facts from your G-E Office.

GENERAL

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.



high torque was not sacrificed to get this

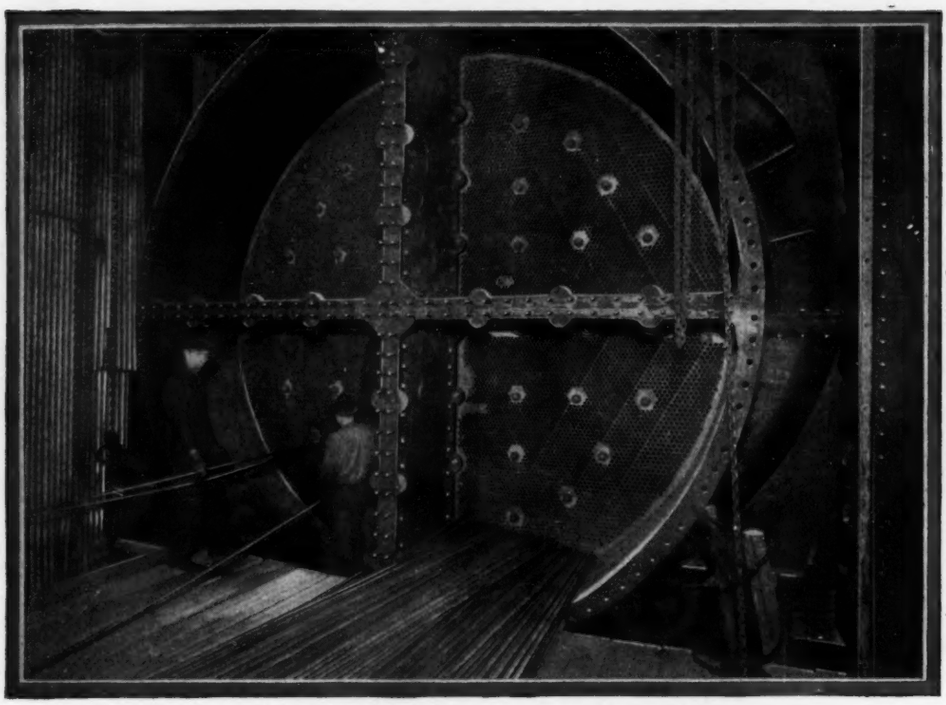
Therefore, its high torque, which has not been sacrificed to obtain over-load accuracy, gives the I-16 meter an indisputable advantage.

Moreover, its high accuracy on overload, which is attained without sacrificing accuracy under varying conditions of temperature, voltage, power factor, and frequency, gives the I-16 meter increased carrying capacity.

600-9

ELECTRIC

SALES OFFICES IN PRINCIPAL CITIES



Anaconda Condenser Tubes being installed in Condenser
No. 4—Hudson Avenue Station, Brooklyn Edison Company.

Care in manufacturing tubes has everything to do with their quality and durability

The American Brass Company produces condenser tubes with even greater care than is required to meet specifications.

Anaconda Condenser Tubes are electrically annealed as a finishing operation. The accurate temperature control made possible by this method has been found to contribute to durability.

Every lot of Anaconda Condenser Tubes is inspected for weight and gauge and subjected to A.S.T.M. tests whether specified or not.

Anaconda Electrolytic Copper and Anaconda Electrolytic Zinc, each guaranteed 99.9% pure, are used in the manufacture of Anaconda Condenser Tubes.

"Anaconda Condenser Tubes", a booklet containing valuable information on condenser tubes, with authoritative specifications, will be sent upon request.

THE AMERICAN BRASS COMPANY
GENERAL OFFICES: WATERBURY, CONNECTICUT

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Philadelphia, Providence, Pittsburgh
Cleveland, Detroit, Cincinnati
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ANACONDA
from mine to consumer

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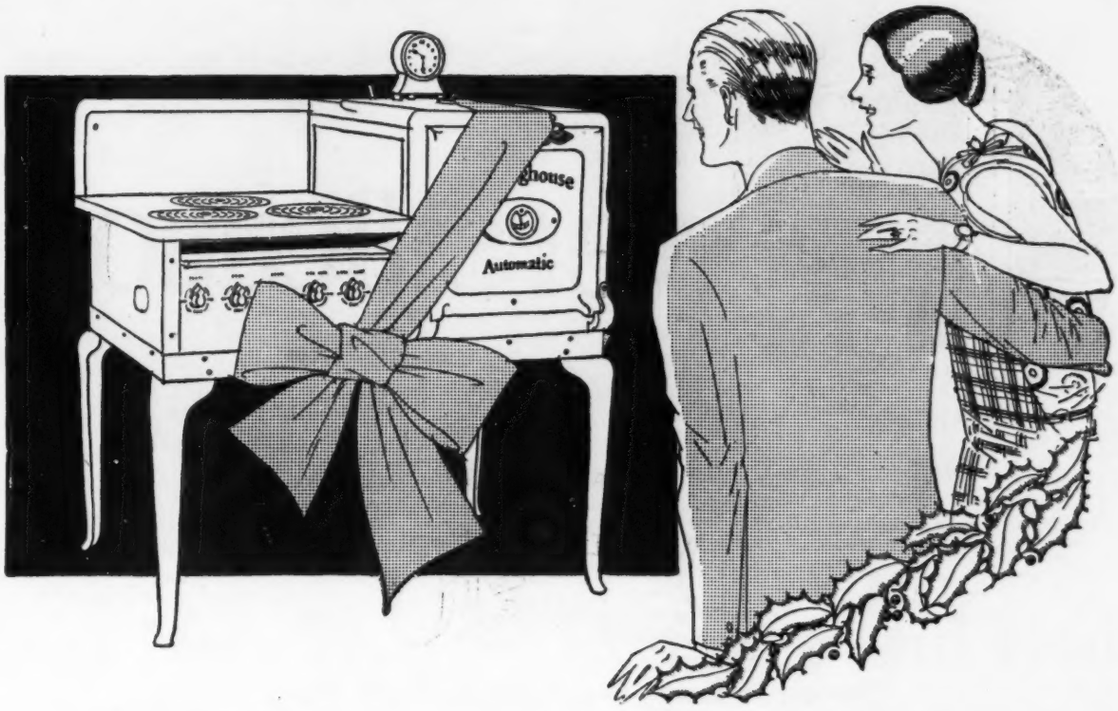
In Canada: ANACONDA AMERICAN BRASS LIMITED, NEW TORONTO, ONTARIO

ANACONDA CONDENSER TUBES

The Most Practical Gift of All



A CHRISTMAS CAMPAIGN

for Load Building and Merchandising Profit!

STIMULATE your range sales during the month of December. Increase the load on your lines. Here's a real opportunity for you to turn the money spent at Christmas time into a profitable channel.

Westinghouse offers plans and materials

In the new Christmas Range Plan Book, Westinghouse offers material and selling plans for a complete range campaign—flexible enough to meet any conditions in your territory.

Advertising material of all kinds

The wide selection of material includes: broadsides, bill stickers, gift tags, newspaper electros, posters and counter cards, Christmas recipe cards, letterheads, selling plans —and can be tied in together in any way you desire to reach every prospect in your section.

See the Christmas portfolio

Go over the Christmas portfolio with your Westinghouse representative. Let him help you work out a plan that exactly fits your territory and conditions. Select your material and premiums—you get the advantage of special discounts on premiums with a Westinghouse campaign.

Or send in the coupon and a Westinghouse man will call.

Mail this coupon today

Westinghouse Electric & Manufacturing Company
Merchandising Department
Mansfield Works Mansfield, Ohio

Westinghouse

X94982

Westinghouse Electric & Mfg. Co.
Mansfield, Ohio

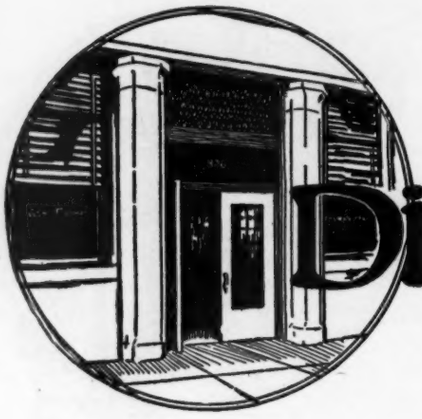
Gentlemen:

I am interested in your complete plans for a Christmas Range Campaign.

Name_____

Company_____

Address_____



Diversification

We Control and Manage

PUBLIC UTILITIES CONSOLIDATED CORPORATION

Serving A Large Population In Eight States

With Electricity, Gas And Water

Since 1917

A Period Of Over Ten Years

Dividends Paid To Investors

In Foshay Securities Alone

Have Reached A Total Of Over

Half A Million Dollars

"For Over Ten Years—All Your Money—All The Time—On Time"

W.B. FOSHAY CO.

INCORPORATED AUGUST 31, 1917

Controlling and Managing Public Utilities---Financing Industrials---Selling Securities of Both

FOSHAY BUILDING
MINNNEAPOLIS

NEW YORK
BOSTON

SAN FRANCISCO
PORTLAND, OREGON
DENVER

CHICAGO
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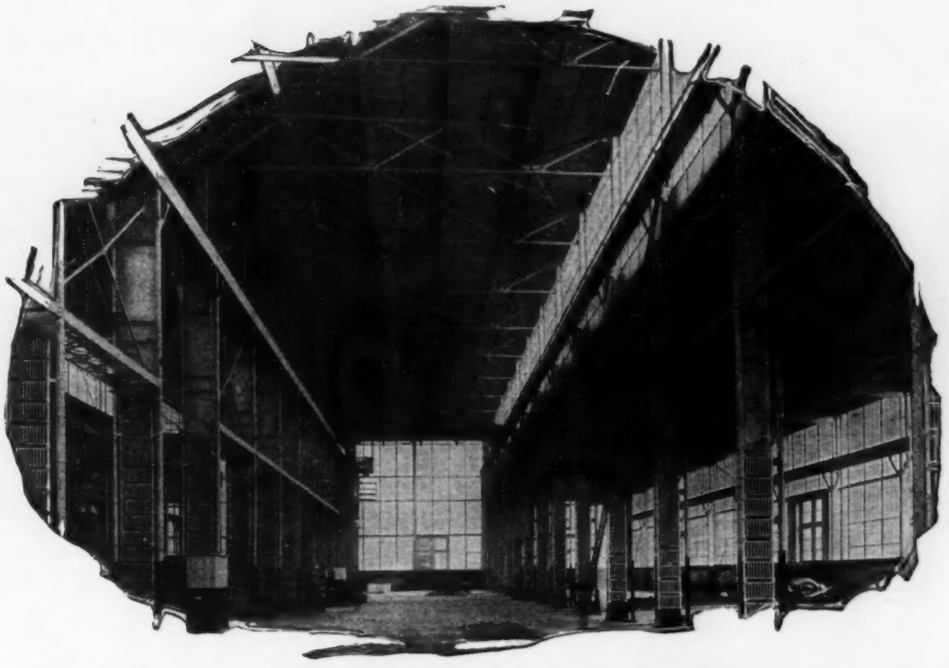


Erecting shop of the Pittsburgh Transformer Co., designed, built and equipped by Austin.

Your New Plant—Designed and Built Under Austin Guarantees

BACKED by years of first-hand experience in building for the ever-changing requirements of the Electrical Industry, the nation-wide Austin organization is prepared to design, construct and equip efficient plants of modern daylighted construction with absolute guarantees covering the total cost of the completed project in advance, delivery date, with bonus and penalty clause if desired, and quality of materials and workmanship.

The success of the Austin Method of Undivided Responsibility is amply demonstrated by more than 85 contracts for General Electric, 6 within seven years for Pittsburgh Transformer and more than 2000 other buildings for various major industries.

From original survey dealing with the advantages or disadvantages of given locations in relation to general industrial conditions to authentic information on local labor conditions, Austin is organized to handle every detail of the entire project with maximum return per dollar invested.

Preliminary sketches, approximate costs, etc., will be furnished promptly. Wire, phone the nearest Austin Office or mail the memo below.

THE AUSTIN COMPANY, *Engineers and Builders,* Cleveland

New York Cincinnati Chicago Detroit Pittsburgh Philadelphia St. Louis Seattle Portland Miami
The Austin Company of Texas: Dallas The Austin Company of California: Los Angeles and San Francisco

AUSTIN

Complete Building Service

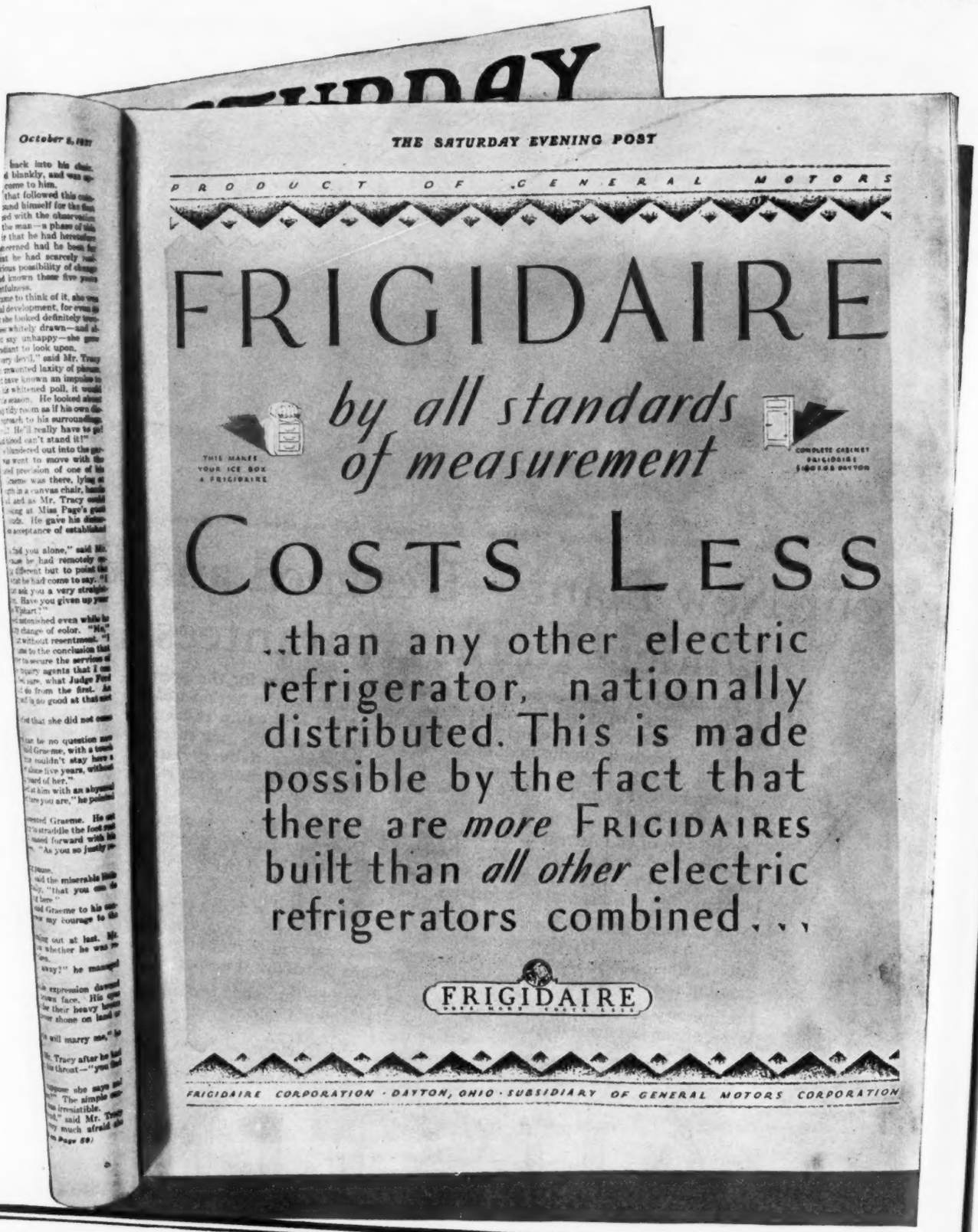
Memo to THE AUSTIN COMPANY, *Cleveland*— We are interested in a

----------project containing----------sq. ft. Send me a personal copy of

"The Austin Book of Buildings." Individual----------

Firm----------City----------

27


THE SATURDAY EVENING POST
PRODUCT OF GENERAL MOTORS
FRIGIDAIRE
by all standards of measurement
THIS MAKES YOUR ICE BOX A FRIGIDAIRE
COMPLETE CABINET FRIGIDAIRE
COSTS LESS
..than any other electric refrigerator, nationally distributed. This is made possible by the fact that there are more FRIGIDAIRES built than all other electric refrigerators combined...
FRIGIDAIRE
FRIGIDAIRE CORPORATION · DAYTON, OHIO · SUBSIDIARY OF GENERAL MOTORS CORPORATION

This Advertisement *will appear in the October 8th Saturday Evening Post, as well as in other magazines and newspapers read by millions of people.*

Thus Frigidaire maintains both advertising and merchandising leadership. And that should guarantee sales leadership to any Public Utility Company holding the Frigidaire franchise.

FRI

Outstanding value

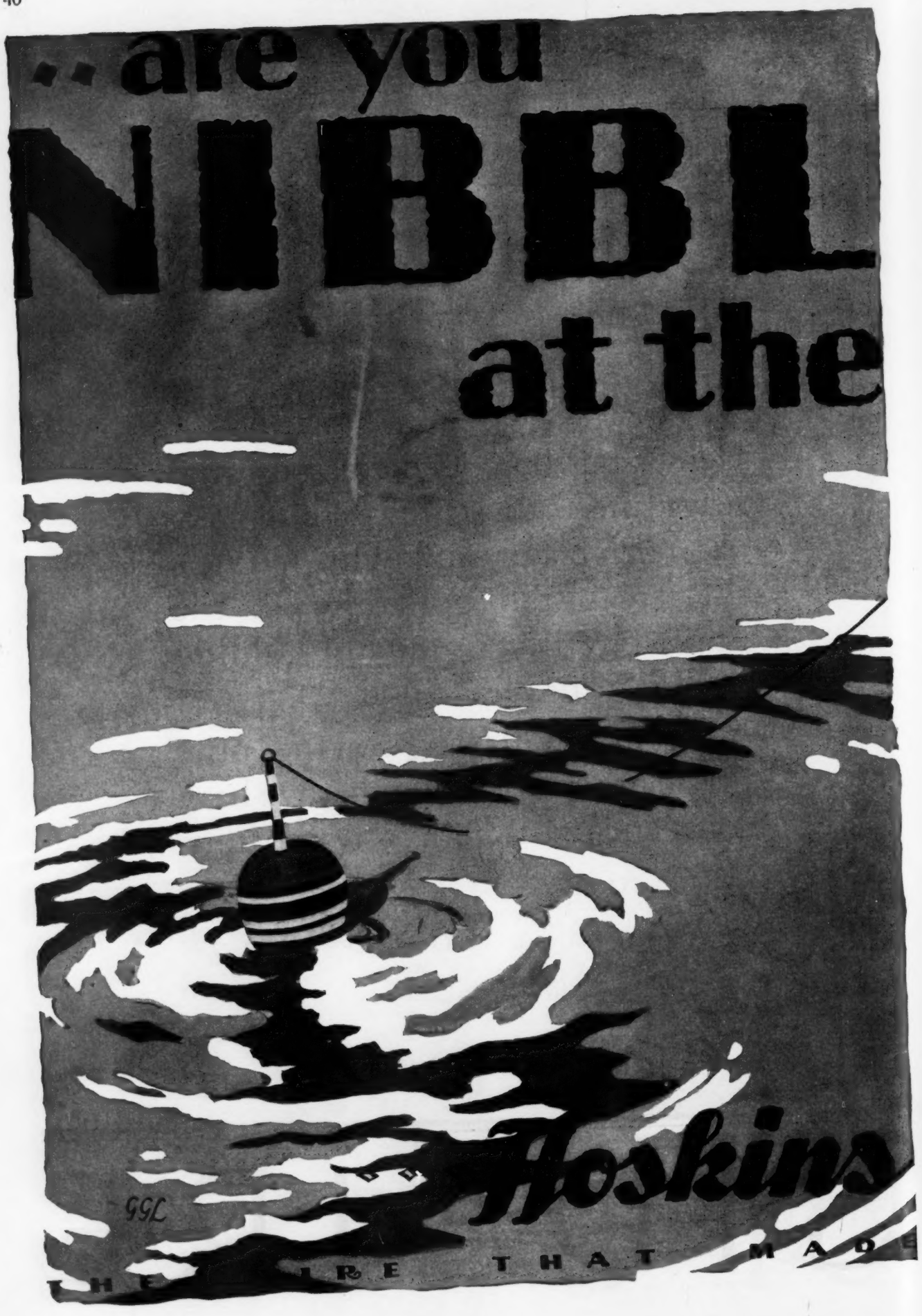
Here is but one of the reasons why Frigidaire is the fastest-selling electric refrigerator, and why it offers the greatest opportunity to the Public Utility Company holding the Frigidaire franchise.

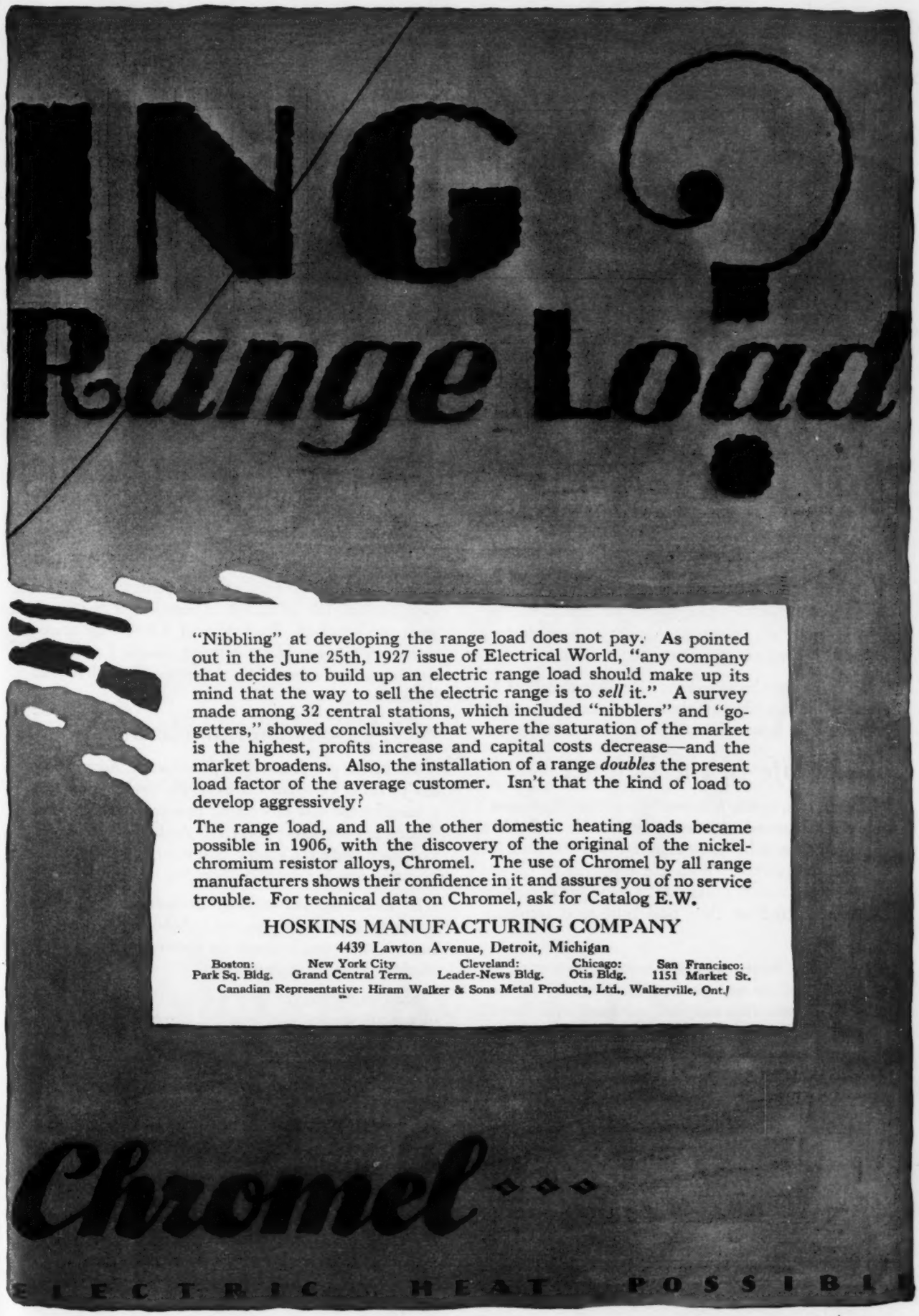
A post card will bring you the entire Frigidaire sales plan—what we have done, and will do, in *your* territory.

Write today.

FRIGIDAIRE CORPORATION
Subsidiary of General Motors Corporation
PUBLIC UTILITIES DIVISION
1775 Broadway, New York City
Dept. Y-215
Dayton, Ohio

GIDAIRE


..are you
NIBBL
at the
Hoskins
HE ARE THAT MADE


ING?
Range Load
"Nibbling" at developing the range load does not pay. As pointed out in the June 25th, 1927 issue of Electrical World, "any company that decides to build up an electric range load should make up its mind that the way to sell the electric range is to *sell* it." A survey made among 32 central stations, which included "nibblers" and "go-getters," showed conclusively that where the saturation of the market is the highest, profits increase and capital costs decrease—and the market broadens. Also, the installation of a range *doubles* the present load factor of the average customer. Isn't that the kind of load to develop aggressively?
The range load, and all the other domestic heating loads became possible in 1906, with the discovery of the original of the nickel-chromium resistor alloys, Chromel. The use of Chromel by all range manufacturers shows their confidence in it and assures you of no service trouble. For technical data on Chromel, ask for Catalog E.W.
HOSKINS MANUFACTURING COMPANY
4439 Lawton Avenue, Detroit, Michigan
Boston: Park Sq. Bldg.
New York City Grand Central Term.
Cleveland: Leader-News Bldg.
Chicago: Otis Bldg.
San Francisco: 1151 Market St.
Canadian Representative: Hiram Walker & Sons Metal Products, Ltd., Walkerville, Ont.
Chromel
ELECTRIC HEAT POSSIBI

Reviving a Business with INDUSTRIAL ADVERTISING

HOW OFTEN have the major markets of some great business disappeared without notice, because of fashion's change, a revolutionary scientific discovery or some strong, uncombatable force.

What is a great business to do? Retire with honor? Or revive with glory? Here is the story of one manufacturer who chose the latter course.

Life in the Balance

The Armistice, shortly followed by the "5-5-3 agreement" on naval limitations, cut this manufacturer's market to a critical fraction of his plant capacity. His corporate life hung in the balance. With the vanishing of the old market, this producer resourcefully turned to a comparatively new, and at that time little used secondary product.

A research bureau was established to determine the adaptability of the new product to different industries. As sales opportunities unfolded, salesmen were trained as specialists in the specific fields. The selling was pitched on the high plane of genuine service to the buyer. There was no promiscuous selling—no knocking at doors in hope that prospects would be found within.

Industrial Advertising, conceived to build industrial recognition for this new product and its salesmen, was planned and scheduled with the same shrewd regard for specialization. The counsel of an experienced advertising agent was obtained. The Industrial Advertising, geared to the self-interests of the different classes of industrial buyers, was persistently published in McGraw-Hill Publications.

A Sensational Recovery

Aided by the power and force of Industrial Advertising, this producer "cheated the mourners" by developing a volume for the new product far in excess of the highest peak of any previous prosperity. And this achievement took place while the general business trend in collateral industries was in a declining direction.

If Industrial Advertising, co-ordinated with an Industrial Marketing plan, can rehabilitate a declining business, who can estimate its power and force when aided by favorable circumstances?

This sensational recovery was not the result of some miraculous chance. It was the outcome of just such common-sense marketing methods as are formulated in the McGraw-Hill book, "Industrial Marketing at Work." If you are an executive interested in the national industrial market, a McGraw-Hill representative will leave a copy of this book with you or your advertising agent. Notify the nearest McGraw-Hill office.

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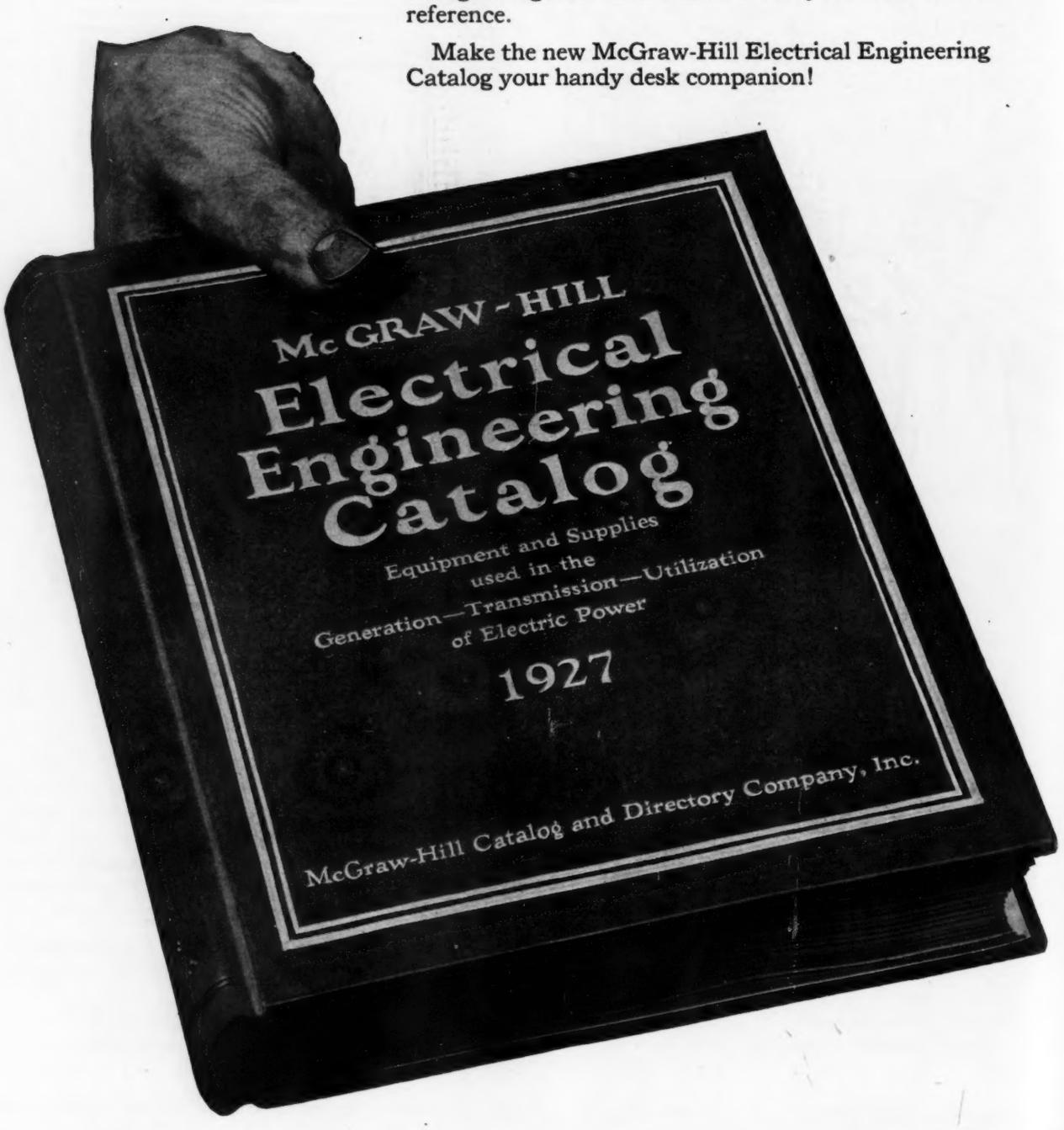
45 000 ADVERTISING PAGES USED ANNUALLY BY 5 000 MANUFACTURERS TO HELP INDUSTRY BUY MORE EFFECTIVELY

Ready to serve you!

Ready to give you instantly the detailed information you seek on the products for the electrical engineering field so that you can wisely specify or purchase.

Here *all under one cover* are the standardized catalogs of more than 200 leading manufacturers—brought together and indexed for your convenient reference.

Make the new McGraw-Hill Electrical Engineering Catalog your handy desk companion!



- - A Portable Catalog File in Usable Form!

THE Magic rubber tube *that cuts delivery cost*

Read what amazingly long life it gives the rugged Exide-Ironclad Battery

THAT odd-looking slotted rubber tube certainly works wonders, but the way it does it is really very simple.

There are dozens of these unique slotted-rubber tubes in the actual Exide-Ironclad Battery, each about as large as a fat lead pencil. Packed in each tube is the active material, where it is held like coffee in a percolator or tea leaves in a cotton bag. The liquid easily penetrates through the slots, but the solid matter is so retained as to greatly prolong the battery's life.

That's why this ingenious principle has doubled battery life. At the same time the Exide-Ironclad is able to maintain a fast speed and develop tremendous power on grades or under heavy loads. The battery charges easily, too, taking current in quickly, and with little waste.

Try one and you'll order more

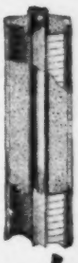
Until you see how smoothly and steadily an Exide-Ironclad Battery hustles your street delivery trucks, you can have no idea how much difference this powerful battery will make in your delivery costs.

Thousands of Exide-Ironclads are now in use all over the country. Leading companies in every line operate them. Many of these companies at first bought one or two Exide-Ironclads for comparison and now use nothing else. Try one of these wonderful batteries in your delivery trucks.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia

Exide Batteries of Canada, Limited, Toronto

The Exide-Ironclad positive plate consists of a metal frame from which extend vertical metal conducting rods, each surrounded by active material and cased in a slotted rubber tube.



Cross-section showing how the rubber tube retains in place and retards the loss of the active material of the plate. The slits give the electrolyte free access to the active material.

Exide
IRONCLAD
BATTERIES

The Electric Storage Battery Company
Allegheny Ave. & 19th St., Philadelphia, Pa.

Gentlemen: Without any obligation on my part please ☐ have your nearest representative call; ☐ send me a free copy of your booklet, "Facts for consideration in selecting a Storage Battery."

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Company _____

Address _____

Street lighting deserves a bigger share of the city budget

Section of Patten Avenue, Asheville, N. C., lighted by G-E Novalux units with 600-c.p. MAZDA lamps, mounted on Elreco poles and brackets.

OUR cities are yearly increasing their appropriations for almost every constructive purpose—except better street lighting, which serves *all* public progress and commercial advantage. Economists assert that two dollars per capita is little enough to pay for adequate street lighting, and yet the average appropriation is at the rate of only ninety cents. A broader public knowledge of the benefits of modern street lighting will inevitably result in a better appreciation of its service.

General Electric specialists will be glad to assist your commercial department to merchandise street lighting. Address the nearest sales office of the General Electric Company.

720-79

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

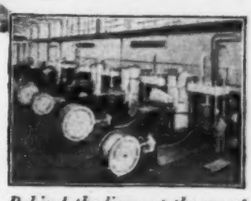
Telephones and Troops

both need behind-the-line support

BACK of the front line soldier there must be a vast machinery of supply. And back of the telephone there is a vast machinery of supply—buying, making, distributing the materials and equipment essential to Bell Telephone service.

To carry out this responsibility Western Electric covers the globe with its purchasing activities, operates the world's largest telephone factory and maintains a nationwide service of distribution from thirty-four telephone supply warehouses.

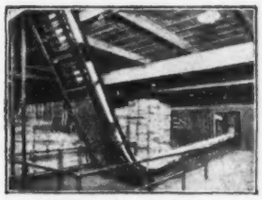
This work involves buying some 8,000 materials from Asphalt to Zinc, and making some 110,000 separate piece parts for telephones and for all that behind-the-telephone apparatus which constitutes ninety-eight percent of the total equipment.



Behind the lines at the great Western Electric cable shop.

Some idea of the men behind the machines behind the lines.

'Way behind the lines—selecting materials from far corners of the earth.



Backing up the telephone with a reliable service of supply.

Western Electric

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General Hydraulic Engineering, including the design, financing, construction and management of hydro-electric power plants.
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A Professional Consultant can many times suggest economical changes of equipment or methods in your plant that will put it on a more efficient operating basis and increase profits by lowering operating costs.
Consult the Advertisements here, for the Professional Consultant Services you require!

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Specialized adviser to American Manufacturers intending to export to Great Britain and Europe.
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Textile Mills; Hydro-Electric Development; Tobacco Products Plants; Cotton, Tobacco and General Warehousing; Industrial Housing; Steam Power Plants; Steam Utilization.
General Offices: Greenville, South Carolina
Branches: Chattanooga, Tenn., Birmingham, Ala.

The J. G. White Engineering Corporation
Engineers—Constructors
Oil Refineries and Pipe Lines, Steam and Water Power Plants, Transmission Systems, Hotels, Apartments, Office and Industrial Buildings, Railroads.
43 Exchange Place New York

Your card here— is like having a traveling representative that offers your services as a Consulting Engineer to 98 per cent of the purchasing power of the Central Station field, *every week!*

It goes on untiringly building prestige for you—making your name familiar in the field—seeking new business, while you are able to devote all your attention to business at hand. The cost is small in proportion to its value as a business aid—only $39.00 for 3 months including subscription to *Electrical World.* Three months order, minimum accepted.

SEARCHLIGHT SECTION

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Positions Wanted, 4 cents a word, minimum 75 cents an insertion, payable in advance.

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INFORMATION:

Box Numbers in care of any of our offices count 10 words additional in undisplayed ads.

Discount of 10% if one payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

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1 to 3 inches.....$5.00 an inch
4 to 7 inches..... 4.80 an inch
8 to 15 inches..... 4.60 an inch

An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page.

E.W.

POSITIONS VACANT

BOILER Room Engineer with at least five years' practical experience and preferably with technical training to take charge of 12,000 H.P. boiler room—Location near New York City. P-97, Electrical World, Tenth Ave., at 36th Street, New York City.

CHIEF engineer; mechanical and electrical, required having specialized knowledge of extra high tension substation equipment and design. Applications stating age, nationality, salary required, full particulars of experience (mechanical and electrical) and where obtained should be marked to the manager, The British Electric Transformer Co. Ltd., Hayes, Middlesex, England.

DISTRIBUTION engineers. Must be technical graduates with experience in designing, estimating and construction of rural and retail distribution work. Give detailed outline of experience, state salary expected and when available. Employment Division, Box 311, Birmingham, Alabama.

DRAFTSMEN, experienced on primary substation and powerhouse work. Positions permanent with chance for advancement. State age, qualifications and salary expected. Employment Division, Box 311, Birmingham, Alabama.

PUBLIC utility in New York State, not New York City, operating large group of properties, has vacancy for an assistant electrical engineer in general engineering office. Complete details of education and qualifications, also salary desired, and recent photograph required in application. P-81, Electrical World, Tenth Ave. at 36th St., New York.

SALES MANAGER for utility in Northern Texas wanted. Must have previous experience. State age, salary expected and qualifications in first letter. P-102, Electrical World, 7 South Dearborn St., Chicago, Ill.

HELP WANTED

METER TESTER

State full particulars as to experience and salary.

P-106, Electrical World
Tenth Ave. at 36th St., New York City

BE A METER ENGINEER
EARN MORE

Use your spare time to help you to a better job. Central stations everywhere pay high salaries to men expert in inspecting and testing meters. **"I got a job here as Meter Expert at a salary of $250.00 per month and give your course in Meter Engineering, which I am studying, the credit for it."—G. R.**

Hundreds earn $3,000 and more. You can do the same. We prepare you at home.

Write today for FREE BOOK and full details

Ft. Wayne Correspondence School
Dept. B. Ft. Wayne, Ind.

POSITIONS VACANT

ELECTRICAL engineers with ability to lay out electrical installation. Should have knowledge of steam plant design and general draughting room experience. Preferably should have experience coal or ore handling installation, surface and underground. Single men preferred. P-115, Electrical World, Tenth Ave. at 36th St., New York.

WANTED: High pressure steam fitter foreman for power plant work; must understand turbine and boiler piping; give experience, age and wages wanted in first letter. Address Box 1371, Charleston, W. Va.

WANTED A-1 Operating Engineers. Must understand both Westinghouse and G. E. Turbines and also some knowledge of the electrical end. One preferred who understands rotary converters. State experience, age, salary, and when available. Box 1371, Charleston, W. Va.

WANTED man for engineering department in small progressive motor factory, about 40 miles from New York City. Must have good technical training and two years' experience in electrical design and windings of small motors. Good opportunity for young man with proper qualifications. State training and experience in full, age, nationality and when available. P-118, Electrical World, Tenth Ave. at 36th St., New York.

EMPLOYMENT SERVICE

IF YOU are qualified for position between $2,500 and $25,000, and are receptive to negotiations for new connection, your response to this announcement is invited. The undersigned provides a thoroughly organized service, established seventeen years ago, to conduct confidential preliminaries, and assist the qualified man in locating the particular position he desires. Not an employment agency. Retaining fees protected by refund provision, as stipulated in our agreement. Send name and address only for description of service. R. W. Bixby, Inc., 262 Main Street, Buffalo, N. Y.

ELECTRICAL World readers find our service effective in making connections. Individual, confidential. Refund agreement. Not agency. Jacob Penn, Incorporated, 9 Park Place, New York.

POSITIONS WANTED

ELECTRICAL Design Draftsman, age, 27, ten years experience on design of central stations, railway and distribution substations, desires position with Public Utility. Location immaterial. PW-100, Electrical World, Guardian Bldg., Cleveland, Ohio.

"Efficient Technical Employment"

The Engineering Employment Agency

154 Nassau St., New York City
An Engineering Employment Service
for Employers and Employees
No Charge to Employers.
Write or Wire Your Requirements

POSITIONS WANTED

AS ASSISTANT to an executive or as mechanical engineer in an industrial, power, coal or metal mining company. Experience (power): erection, installation and supervision of steam and electrical power equipment and air compressors. (General): conveying, hauling, hoisting and ventilating equipment. (Special): 15 years' intimate contact with coal mine operation throughout U. S. and Canada. Graduate M. E. Excellent references. Position with good future more important than immediate salary. PW-109, Electrical World, Tenth Ave. at 36th St., New York.

ELECTRICAL Engineer, 18 years' experience, office and field, familiar with design, construction and operation of public utility steam and hydroelectric generating stations, substations, transmission, line calculations, distribution systems, factory, field and laboratory testing. Industrial power applications and maintenance in plants and buildings. Resident and Office Engineer for Engineering firm, in charge Engineering office public utility, teaching staff Engineering school. Will consider connections with Public Utility, Engineering or Industrial Firm. PW-91, Electrical World, Tenth Ave., at 36th Street, New York.

ELECTRICAL design engineer or construction superintendent experienced on substation, power house, industrial plant design and construction, steel mills, paper pulp mills. 2½ years' industrial control design. 14 years' experience. Registered engineer. Main P. O. Box 284, Chicago, Illinois.

ELECTRICAL engineer or assistant, with public utility or large industrial, age 33 years, with extensive experience on electrical problems, especially high tension switching and distribution, 5 years with W. E. & M. Co. Will go anywhere, reasonable salary. PW-116, Electrical World, Guardian Bldg., Cleveland, Ohio.

When Writing Your Ad

Provide an indexing or subject word.

Write it as the first word of your ad.

If it is a Position Wanted or Position Vacant ad, make the first word the kind of position sought or offered.

This will assure proper classification in the column.

The right is reserved to reject, revise or properly classify all Want Advertisements.

Proper Classification increases the possibility of Prompt Returns

Telephones: Palisade 2600-2601

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300 kw., 250/500 v., 3 ph., 60 cy., 2300 v. Westinghouse synch. motor generator set.
1—250 kw., 250 v., G.E. Generator, 3 ph., 60 cy., 2200 v. synchronous motor.
200 kw., 600 r.p.m., 250 v. Gen., 3 ph., 60 cy., 440/2200-v. synchronous motor.
150 kw., 600 r.p.m., 250 v. Gen., 3 ph., 60 cy., 220/440 v. G.E. synchronous motor.
1—125 kw., 250 v. Westinghouse synchronous generator motor set.
1—100 kw., 125 v., D.C., 220/440 A.C., G.E. synchronous motor generator set.
100 kw., 250 v. Gen., 900 r.p.m., 2200 synchronous motor.
1—75 kw., 250 v. Generator, 3 ph., 60 cy., 2200 v. synchronous motor.
1—50 kw., 250 v. Westinghouse, 3 ph., 60 cy., 220/440 v.
1—37 ½ kw., 900 rev., 110 v., D.C., on same base with 60-hp. Lincoln 220 v., sq. cage motor.
0-20-25-40 kw., 125 v. Exciter Sets.
0-20-30 kw. Balancer Sets.
—5 kw. Battery Charging Sets.

TRANSFORMERS

4—150 kw., 4150 v., 120/240 Pittsburgh Oil Cooled Transformers.
15—5 kw. to 30 kw., 3 ph. Pole Type, 2200/1100 440/220/110 G. E.

A. C. GENERATORS

No.	*Kw.*	*Rpm.*	*Volts*	*Ph.*	*Type*
1	300	450	2300	3	G. E. P.
1	0	600	440	3	Westg.
2	150	600	220/440/2200	3	Wagner
2	100	900	2300	3	G. E.
1	75	900	2300	3	G. E.
1	50	1200	220/440	3	G. E.

A. C. ENGINE GENERATOR SET

1—25 kw., 125/250 volt, 3 wire General Electric Gasoline Engine Set, new.

MOTORS—3 PHASE, 60 CYCLE

H. P.	*R. P. M.*	*Volts*	*Type*
1 500	360	220/440	Westg. HF. sl.rg.
1 400	450	2200	G. E. synch.
300	300	2200	Westghse. synch.
4 200	514	2300/440	G. E. synch.
1 180	400	440/2300	Burke sl.rg. 3 brg.
2 175	600	220/440/2200	Wagner synch.
1 150	900	2300	G. E. synch.
1 150	600	2200	Westghse. sq. cage
1 50	600	2200	G. E. MT. sl. rg.
1 150	1200	220	Elec. Machy. syn.
1 150	1800	2200	Westg. sq.cg. motor
1 25	900	440/2200	Cr. Wheeler
1 100	900	440/2200	G. E.
1 100	900	220/440/2200	West.
1 75	600	220	G. E. sq. cg.
1 75	720	220	Westg., C.W.
1 75	490	440	Allis-Chal. S. R.
1 75	900	2200	G. E. KT.
1 60	1200	220	G. E. sl. rg.
1 60	300	220/440/2300	Fair.-M. Syn. Mtr.
3 50	900	220	G. E. sq. cg.
1 50	900	2200	G. E. B.
1 50	1200	220/440	Wagner sl. rg.
1 40	1700	220/440	Westghse. sl. rg.
1 25	1200	440	G. E. K.
1 25	900	220	West C. S.
1 7½	900	220/440	G. E. MT.
2 2	1800	220/440	G. E.

(2 Phase Motors on request)

BRAND NEW MOTORS

8	7½	900	220-440	Gen. Electric	MT
1	10	1200	220-440	Gen. Electric	MT
3	15	1200	220-440	Gen. Electric	MT
1	15	1200	220-440	Gen. Electric	KT
5	25	600	220-440	Gen. Electric	KT
3	25	900	220-440	Gen. Electric	KT
1	30	900	220-440	Gen. Electric	KT
3	30	1200	220-440	Gen. Electric	KT
1	40	1200	220-440	Gen. Electric	MT
1	40	900	220-440	Gen. Electric	KT
1	40	1200	220-440	Gen. Electric	KT
1	60	720	220-440	Gen. Electric	KT

D. C. GENERATORS—250 VOLT

No.	*Kw.*	*Rpm.*	*Type*
1	250	450	G. E.
1	200	500	West.
1	150	600	G. E.
1	100	720	G. E.
1	75	450	Diehl
1	50	600	Westghse.
1	30	1000	Westghse.

(Smaller sizes on request)

D. C. GENERATORS—125 VOLT

5, 10, 20, 22, 35, 50, 2-100 kw.
3—21 kw. 1250 r.p.m. Sprague

D. C. MOTORS—230 VOLT

No.	*Hp.*	*Rpm.*	*Type*
1	350	450	G. E.
1	200	550	West.
1	150	1100	West. SK
1	100	625	Westg. type S.
1	80	500	Allis-Chalmers
2	75	475	Westg. type S
1	50	560	Westghse SK
1	50	200	Diehl
1	50	650	Sprague
1	40	400	Diehl
1	40	1300	Diehl
1	35	200	Diehl
1	35	700	Cr. Wheeler
1	35	420	Diehl
1	20	665	Diehl
1	20	200	Diehl
1	20	900	Diehl
1	15	1050	Cr. Wheeler CM
1	10	375/750	Westg. S. var.sp.
8	10	1350	Rochester

(Smaller sizes on request)

D. C. MOTORS—125 VOLT

1	150	600	G. E.
1	100	675	G. E.
1	80	600	G. E.
1—65 hp. motor.	General Electric		Type CL 550/605
3	25	1200	Sprague
1	20	650	G. E.
1	15	775	SK Westghse.

POSITIONS WANTED

ELECTRICAL engineer, single, age 26; eight years' experience on construction, operation, maintenance and commercial work; familiar with distribution and transmission engineering and operation; employed as division superintendent of large group of towns for past three years; excellent references as to character, loyalty and ability; available 30 to 60 days; prefer position with operating company in South America that offers opportunity for future advancement. PW-104, Electrical World, 1600 Arch St., Philadelphia, Pa.

GRADUATE engineer—over four years in commercial engineering field with public utility; specialized in rate analysis and application; experience in industrial sales and public relations activities; preparation of proposals and contracts. PW-98, Electrical World, Tenth Ave. at 36th St., New York.

SALES ENGINEER, technical education, twenty years' experience consulting and sales work, salary or commission account, New York preferred. PW-110, Electrical World, Tenth Ave. at 36th St.,, New York.

POSITIONS WANTED

NEW business manager — university and technical graduate having had public utility operating and sales experience desires position as new business manager. Age 30, available on reasonable notice. Best of references can be furnished. PW-71, Electrical World, Tenth Ave. at 36th Street, New York.

POSITIONS WANTED

POSITION wanted by man 21 years in electrical field. Now employed as superintendent of hydro plant. Can take charge of city work also. Must have good school advantages. PW-99, Electrical World, 7 So. Dearborn St., Chicago, Ill.

Available as Manager or Superintendent

Electrical engineer, Member A. I. E. E., with a background of responsible executive employment in electric railway operation (surface and rapid transit) and in association with prominent manufacturers of electric railway and power equipment.
This knowledge and experience should be particularly valuable to an operating or holding corporation that needs a better understanding of its railway and power equipment.
Now employed, desire to change.
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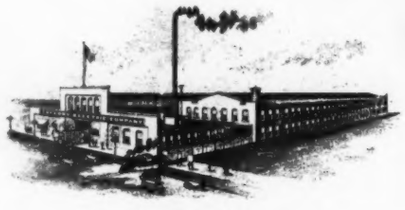

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Rebuilders of Hi-Grade Electrical Machinery
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Lincoln, Sixteenth and Wood Streets
CHICAGO, ILLINOIS

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(Continued from pages 50 and 51)

SALES ENGINEER—University trained mechanical and electrical engineer, qualified by technical, sales and executive ability, together with broad experience to get results. Age 34. Immediately available. Will travel. PW-112, 7 So. Dearborn St., Chicago, Ill.

STEEL electrical engineer, college graduate, with 4 years' experience in power plants, substations, industrial control and steel mill engineering, desires new connection. PW-111, Electrical World, 1600 Arch St., Phila., Pa.

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Alternating Current Generator

1—800 to 1250 Kva., 3 phase, 60 cycle, 2300 or 440 volts, direct connected to **uniflow steam or modern simple corliss engine.**

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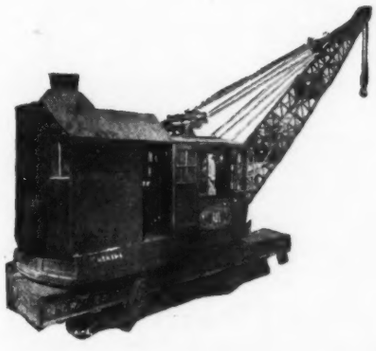

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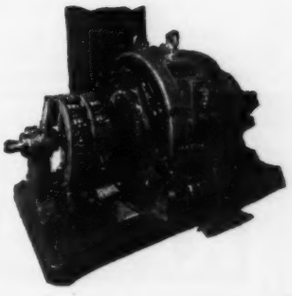

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We have handled the rewinding of transformers aggregating over 5100 kva. for this customer. The superintendent writes that he has checked the bills for this work, and finds that they total LESS THAN HALF the cost of equivalent new equipment.

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25 CYCLE EQUIPMENT—
Attractive Prices

1—250 hp. General Electric Squirrel Cage, 440 volts, 1500 r.p.m., $1000.00.

2—200 hp. Westinghouse Slip Ring, Type CW, 3 bearing, 750 r.p.m., 440 volts. Complete $1000.00 each.

1—150 hp. Wagner Sq. Cage, 750 r.p.m., 440 volts. Complete $600.00.

1—120 hp. Allis-Chalmers Slip Ring, 750 r.p.m., 440 volts, crane type. Complete $600.00.

2—75 hp. F and M Type B, 550 volts, 3 phase, 750 r.p.m. Complete $450.00.

1—50 hp. Gen. Elec. Type I, Form M, 440 volts, 3 phase, 500 r.p.m., Slip Ring. Complete $550.00.

3—40 hp. Gen. Elec., Type I, 440 volts, 25 cycle, 3 phase, 1500 r.p.m., vertical motors. $250.00 each.

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1—300 kw., 375 kva. General Electric 3 ph., 60 cy., 240/480 v., 150 r.p.m. Alternator, direct connected to 21x30 side crank 4-valve heavy duty Erie Ball Engine. Unit installed new in 1923—exceptional condition. instant shipment.

2—Units each as follows: 105 kw., 125 kva. General Electric revolving field type Alternators, 3 ph., 60 cy., 240/480 v., 257 r.p.m. direct connected to 14¼x16 side crank Buckeye Automatic Engine, complete with exciter and rheostats.

1—50 kva. Burke 2 or 3 phase, 240/480 v., 60 cy., 300 r.p.m. Alternator, direct connected to 12x12 Erie Ball center crank Automatic Engine, practically new.

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126 Liberty St., New York City Telephone—Rector 4025

POWER APPARATUS

1—3000 kw. General Elec. Turbo Generator with condenser, etc.

2—1000 kw. General Elec. Turbo Generators.

1—780 kva. Westinghouse Turbo Generator.

3—300 kw. turbo generator units.

1—90 kw. turbo generator.

3—85 kva. A.C. generator to 125 hp. American Diesel engines.

1—200 kw. West. Elec. A.C. Generator to Skinner Unaflow.

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DIESEL OIL ENGINE UNIT

consisting of McIntosh & Seymour Diesel Oil Engine, 665 HP., direct connected to G.E. Generator, 3 phase, 60 cycles, 625 K.V.A., 2300 volts, 150 R.P.M., with accessories constituting a complete operating unit.

We have the exclusive sale of this equipment. Write us for Bulletin No. 22-B giving complete description and for a price.

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Steam and Electrical Machinery
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500 hp., 1150 r.p.m. 440 v. 60 cyc. 3 ph.
100 hp., 690 r.p.m. 440 v. 60 cyc. 3 ph.
85 hp., 720 r.p.m. 2080 v. 60 cyc. 3 ph.
Above motors are squirrel cage.
150 hp., 600 r.p.m. 440 v. 60 cyc. 3 ph.
50 hp., 870 r.p.m. 440 v. 60 cyc. 3 ph.
2 above motors are slip ring with control.
Electrical Repair & Equipment Co.
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MOTOR BARGAINS
200 hp., 450 r.p.m., 440 v, 60 cy., 3 ph., G.E.
150 hp., 490 r.p.m., 440 v., 25 cy., 3 ph., Allis.
100 hp., 900 r.p.m., 440 v., 60 cy., 3 ph., G.E.
70 hp., 450/225 r.p.m., 230 v., D.C., General Electric variable speed with control panel.
Overhauled and Guaranteed. Low Prices.
V. M. NUSSBAUM & CO., Ft. Wayne, Ind.

68
66
2

Sixty-six from Sixty-eight leaves Two—just simple Arithmetic and the answer is the number of 823 H.P. Boilers now on hand at Old Hickory.

Originally there were 68 of these splendid 823-hp. Babcock & Wilcox Stirling boilers installed at Old Hickory to do their part in the winning of the World War. After a few months' use they were offered to the power users of America and now 66 of the boilers are in service in 17 different states. You will note that 26 of the boilers are in three states—Ohio, Michigan and Illinois—states which have the most rigid code requirements. Constructed under A.S.M.E. code requirements these boilers will meet practically any insurance or law requirement. Complete specifications and drawings on request.

Where They Went

West Virginia	8
New Hampshire	2
Washington	2
Ohio	12
North Carolina	3
Missouri	2
Connecticut	4
Michigan	6
Mississippi	2
New Mexico	2
Pennsylvania	1
Texas	1
Minnesota	2
Nebraska	5
Illinois	8
Iowa	2
Arkansas	2
Total	66

SPECIFICATIONS

823 hp. Stirling Water Tube Steam Boilers, as purchased from Babcock and Wilcox Company.

Class M-30, each unit having 8226 sq.ft. heating surface, in accordance with following specifications and A.S.M.E. Code.

The heating surface of each boiler consists of three steam and water drums and a mud drum, as follows:

3—Steam Drums 42" diameter, 17'1⅜" long, ⅞" plate.

1—Mud Drum, 48" diameter, 16'7⅝" long, 1" plate.

Drums connected by 630 tubes, 3¼" in diameter.

Space occupied by each boiler 18'0" wide, 23'3" deep, 29'9" high.

Shipping weight of boiler only, approximately 50 tons.

TUBES

Tubes, 3¼-inch, hot rolled seamless steel, No. 10 gauge, for working pressure of 180 pounds to and including 225 pounds.

VALVES AND FITTINGS:

Each boiler supplied with the following valves and fittings:

4—4½" Safety Valves, nickel seat, set to blow at 200 pounds.

1—15" Ashcroft Steam Gauge with 12", 400-lb. dial.

1—Water column fitted with bronze mountings for glass water gauge and three try cocks with lifting handles.

1—3" Bronze Stop Valve and one 3" Bronze Check Valve for feed.

2—2½" Blow-Off Valves and two Stop Cocks.

STEAM OUTLET:

The main steam outlet flanged, 8 inches in diameter, with 15-inch flange.

SUPPORTS:

Each boiler supported on a steel framework entirely independent of the setting to allow for contraction and expansion without straining either the boiler or the brickwork and to allow repairs or renewal of the latter without disturbing the boiler or its connections.

WORKING PRESSURE

The boilers were constructed for a working pressure of 200 pounds per square inch. All drums were tested and made tight under hydrostatic pressure of 300 pounds.

ACCESSORIES:

Accessories furnished in addition to those mentioned:

1—8" Foster non-return Valve.

1—6" Element Vulcan Soot Blower complete with all piping and valves.

STOKERS:

8-retort Westinghouse double dump underfeed stoker with line shaft, sprockets, transmission guards, extension coal hopper and 1—8"x8" Buffalo vertical engine, single acting, inclosed type, Class A, rated at 32 hp. 350 r.p.m., equipped with one 2½" Buffalo governor.

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New and Used Selected Bargains

Slip Ring Motors

H.P.	*Make*	*R.P.M.*	*Ph.*	*V.*	*Type*
10	Watson	1200	3	220	
7½	Lincoln	1800	3	550	
7½	G.E.	900	3	220	M.T.
7½	G.E.	1800	3	440	M.T.C.
5	G.E.	900	3	220	M.T.C.
5	G.E.	1200	2	220	M.Q.

Squirrel Cage Motors (3 Ph., 60 Cy., 220/440)

H.P.	*Make*	*R.P.M.*	*Type*
50	G.E.	1200	K.T.
50	G.E.	900	K.T.

Large stock of Motors from ¼ to 300 hp. Also Generators and Motor Generator Sets of all characteristics.

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SELECT BARGAINS

Slip Ring Motors, 220/440 Volt, 3 Ph., 60 Cy.

1—200-hp. Westing., Type CW, 514 r.p.m.
2—200-hp. Fairbanks-Morse, Type BV, 600 r.p.m.
1—200-hp. Crocker-Wheeler, Type AQ, 600 r.p.m.
1—75-hp. Allis-Chalmers, 865 r.p.m.
2—40-hp. Westgh., Type CW, 690 r.p.m.
2—30-hp. Westgh., Type CI, 870 r.p.m.

Synchronous Motor Generator Sets

8 New Westinghouse 3 Bearing, A.C., Type G, 50 Kva., 220 v., 3 ph., 60 cy., 1200 r.p.m., D.C., Type SK-150½, 125 volt.

Photo, Particulars and Price on Request.

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HIGH GRADE STANDARD EQUIPMENT

Slip Ring Motors—3 Ph., 60 Cy.

Hp.	Volts	Make	Speed
200	440-220	G.E.	450
200	2200	G.E.	1800
200	220-440	G.E.	600
150	220-440-550	G.E.	600
100	440-220	G.E.	720
100	2200	G.E.	1800
75	440-220	G.E.	900
60	550	G.E.	900
60	2200	G.E.	600
60	550	G.E.	514
50	220-440	G.E.	1200
50	220-440	G.E.	900
30	220-440	Westghse.	900
25	220-440	G.E.	900
25	220-440	G.E.	1200

Sq. Ca. Motors—3 Ph., 60 Cy.

125	2200	G.E.	514
100	550	G.E.	900
100	220-440	G.E.	900
75	220-440	G.E.	900
75	2200	G.E.	900
50	220-440	G.E.	900
50	550	G.E.	900
40	220-440	G.E.	1200
30	220-440	G.E.	1200

Direct Current Motors

150	230	875	General Electric	DLC
130	115	1200	General Electric	RC
125	125	900	General Electric	RC
100	230	950	General Electric	RC
75	230	600	General Electric	DLC
75	230	700	Westghse.	S
50	230	650	General Electric	RC
50	230	750	Westghse.	SK
30	115	1100	General Electric	RC

Direct Current Generators

Kw.	Volts	Speed	Make	Type
150	125	400	General Electric	MPC
100	250/125	950	General Electric	RC
90	125	1150	General Electric	RC
75	250	700	General Electric	DLC
65	125	800	Westghse.	SK
50	250	750	General Electric	RC
50	250	850	Westghse.	SK

Motor Generator Sets

1—220-kw., 250-v., 514-r.p.m., Westghse, D.C. with 300-kva., 2200-v., 3-ph., 60-cy., syn.

1—75-kw., 125-v., 1200-r.p.m., G.E., Gen. connected to 112-hp., 220-440, 3-ph., 60-cy., sq. cage motor.

A. C. Generators

1—187-kva., 720-r.p.m., 2200-440-220-v., 3-ph. 60-cy., G. E. belted exciter.

1—150-kw., 600-r.p.m., 2200-440-220 G. E. belted exciter.

1—115-kva., 900-r.p.m., 2200-v., 3-ph., 60-cy., Allis-Chalmers, direct connected exciter.

1—1121-kva. 900-r.p.m., 2200-v., 3-ph., 60-cy., G. E. direct connected exciter.

1—30-kw., 1200-r.p.m., 2300-440-220-v., 3-ph. 60-cy., G. E. belted exciter.

Turbo-Generators

1—500-kw., Westghse., 2300-550-440-v., 3600-r.p.m., 3-ph., 60-cy., with baro. condenser.

1—125-kva., 240-480-550-v., 3-ph., 60-cy., 900-r.p.m., Westghse., A. C. Generator with direct connected exciter, geared to Westinghouse non-condensing 7200-r.p.m. turbine.

1—35-kw., Westghse., 125-250-v., D.C., 1200-r.p.m., 3-wire, connected to 7200-r.p.m. Westinghouse geared turbine.

1—35-kw. G.E. 125-volt, D.C., 3600-r.p.m., connected to Curtis turbine.

Engine Generator Sets

1—55-kw., 2300-480-240-v., 300-r.p.m., G.E Type ATB, connected to 11x12 Ames side crank engine.

STEPHEN HALL & CO., INC., 7th and Adams Sts., HOBOKEN, N. J.

GENERAL ELECTRIC VOLTAGE REGULATORS

We have a number of 100 amp., 60 cycle, 2300 volt, type IRS General Electric voltage regulators complete with operating motor, relay, resistor, contact making voltmeter, current and potential transformers which we will sell for $200.00 each. At this price there is no excuse for not giving your customers good voltage regulation.

GEORGE SACHSENMAIER CO.
8401 Hegerman St., Holmesburg, Phila., Pa.

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Magnet Wire (*new*)

7,000 pounds.
Write to C. W. LEPPER,
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435 Sixth Avenue, Pittsburgh, Pa.

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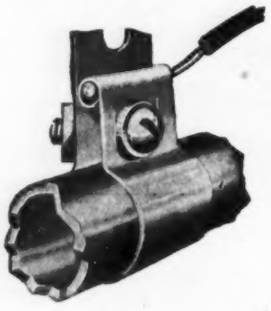

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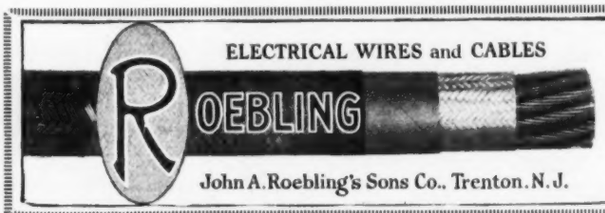

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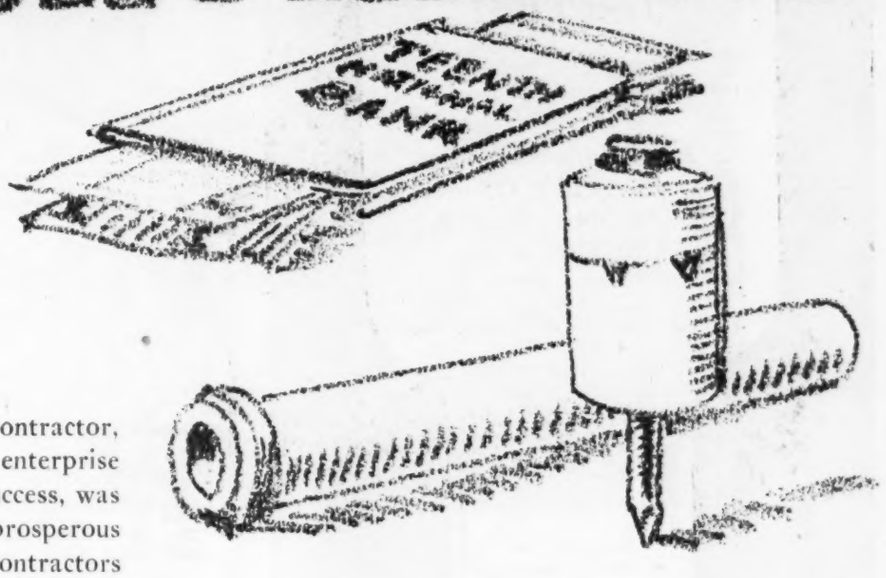

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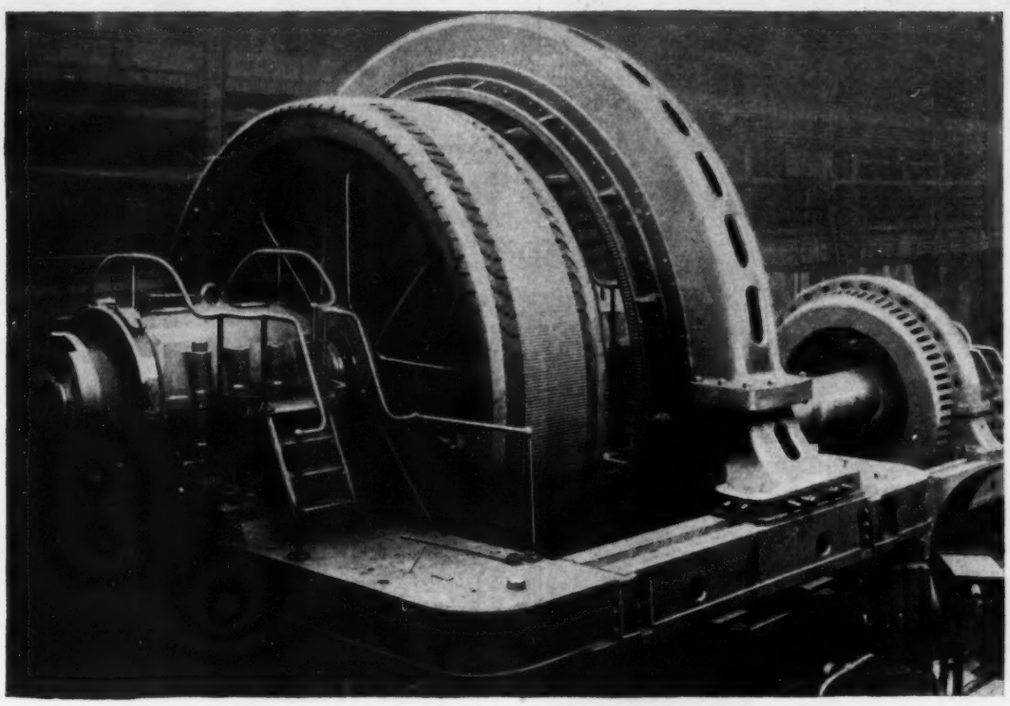

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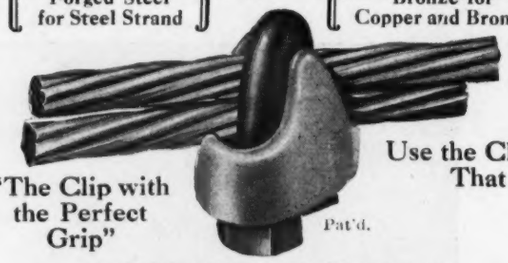

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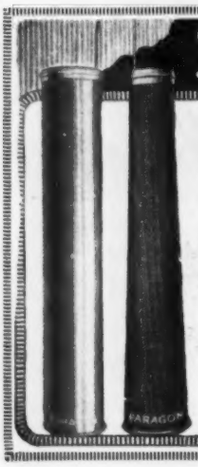

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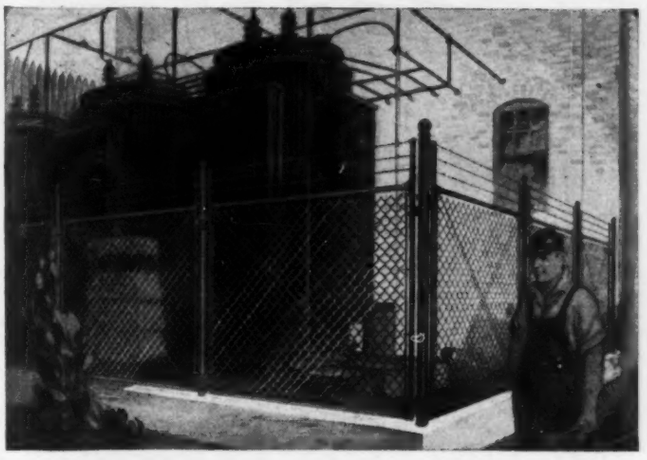

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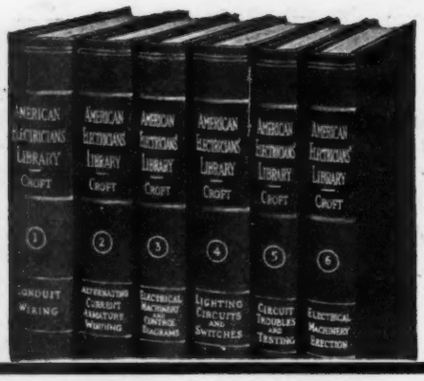

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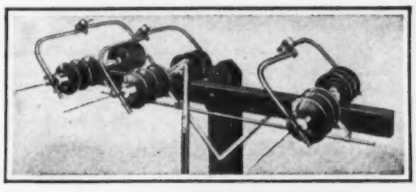

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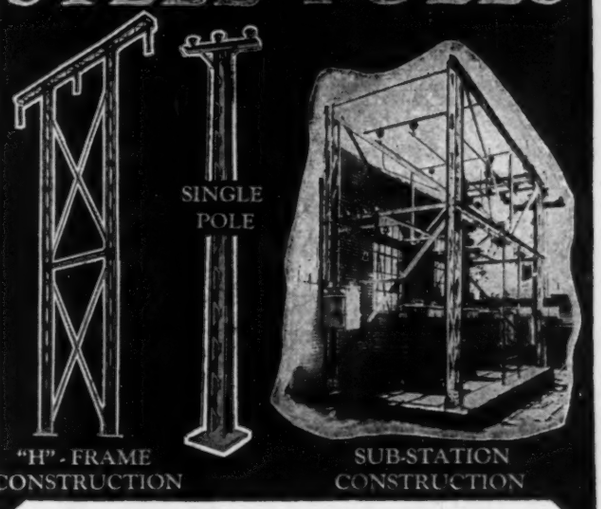

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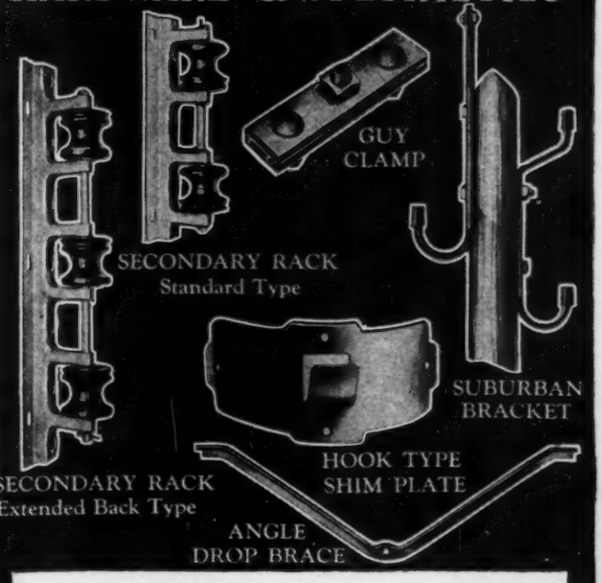

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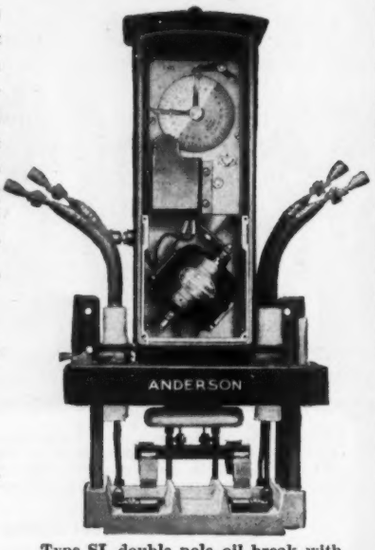

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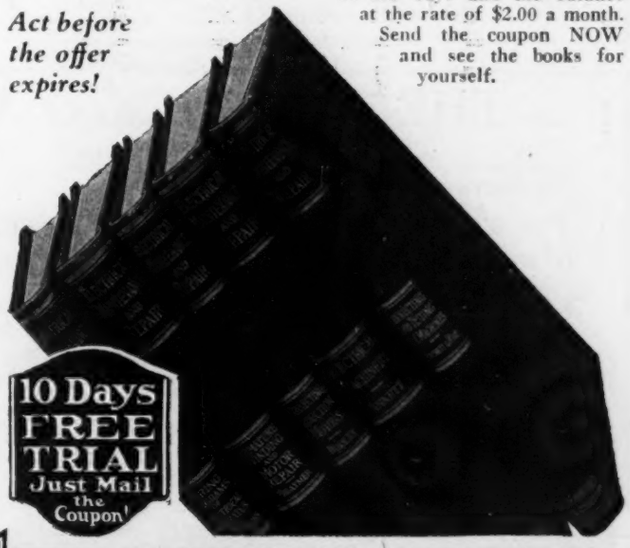

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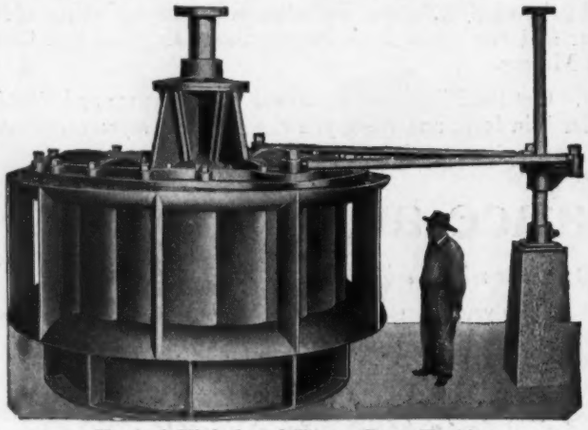

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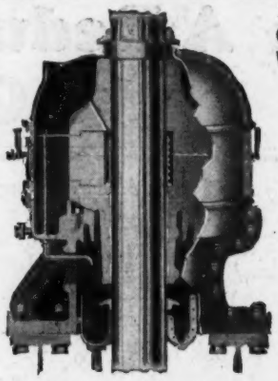

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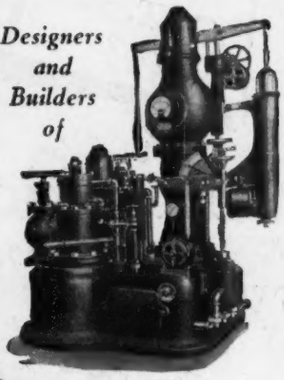

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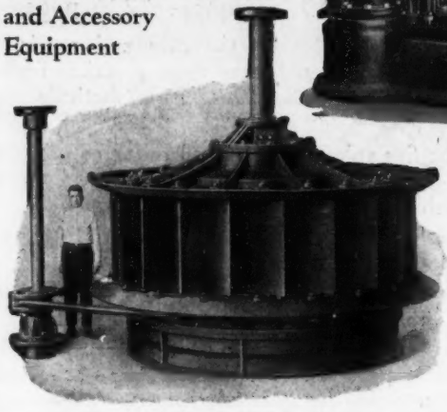

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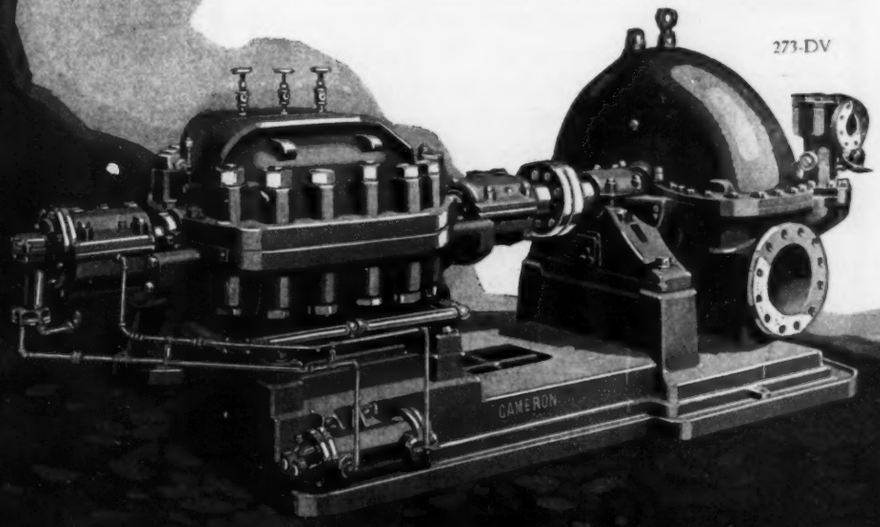

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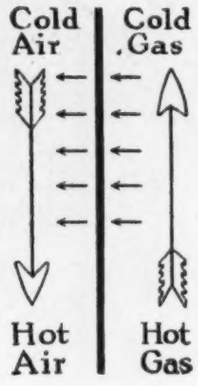

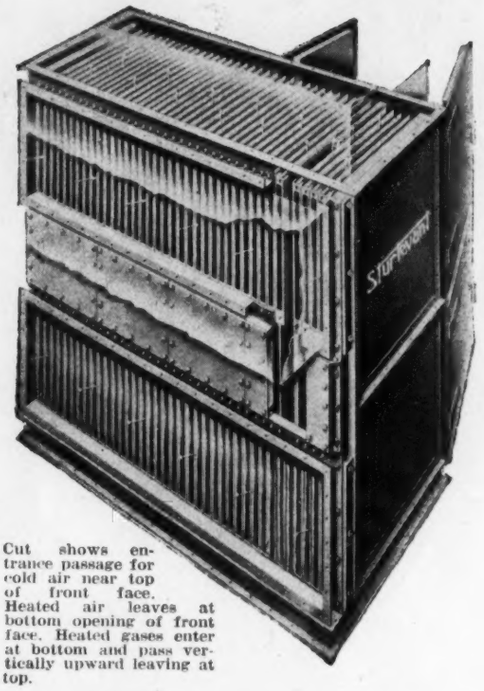

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Basic types; Advantages and disadvantages; Applications; Cost of operation; Mechanical details; Sizes and data on Worthington types.

Deep-well Pumps

Description of rotating types; AXIFLO and CONIFLO Pumps; Range of capacities; Characteristic curves; Fields of application; Reciprocating types; GLENDORA.

Power for Pump Drives

Oil-engine, gasoline-engine, kerosene-engine, waterwheel, steam-turbine and electric-motor drives; Fields of application; Advantages and disadvantages; Electrical data.

Direct-acting Steam Pumps

Types and application; Selection and calculation of sizes; Waterworks pumping engines; Sizes and data on Worthington types.

Installing and Operating Pumping Machinery

General instructions for erecting, starting up and operating pumps of all types; Piping arrangements; Valve adjustments.

Pumping in the Petroleum Industry

Analysis of requirements; Properties of oil; Flow laws; Well pumping; Pipe-line pumping; Loading and unloading; Refining; Data on Worthington pumps for all of these services.

Tabular Section

Tables of weights and measures, U. S. and Metric; Conversion and equivalent tables; American pipe standards; Fire-stream nozzle, discharge and pressure tables.

WORTHINGTON PUMP AND MACHINERY CORPORATION
115 BROADWAY, NEW YORK CITY

39-6071-8-10

Gentlemen:

Please send me circular No. 6071-3 describing your Pump Hand Book, together with specifications for receiving free copy. I assume no obligations.

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The World's Largest Automatic Plant

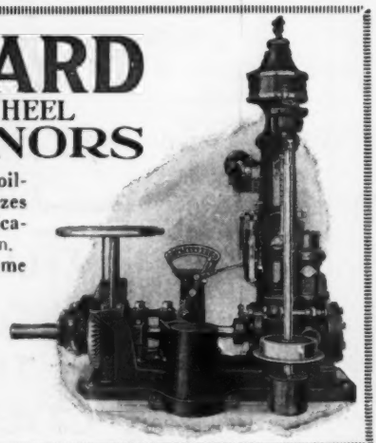
Twenty thousand horsepower is the record capacity of the full-automatic vertical reaction Pelton turbine installed in the Glines Canyon plant of the Northwest Power & Light Co., this unit having been in operation since April 30th. Following a month of service under full load the turbine was officially tested by the Allen Salt Velocity method with most gratifying results. A liberal overload capacity at high efficiency was shown by these tests, which is extremely desirable in view of the conditions under which this plant is to operate.

Every detail of the automatic equipment has functioned perfectly, a matter of considerable interest since this is the largest capacity full automatic turbine yet built. All design and construction was carried on in our San Francisco works.

THE PELTON WATER WHEEL COMPANY
Hydraulic Engineers
2983 Nineteenth St., San Francisco 100 Broadway, New York
Associated Companies: I. P. Morris Corporation, Philadelphia; Dominion Engineering Works, Montreal.

PELTON

LOMBARD
WATER WHEEL
GOVERNORS



Powerful, quick-acting oil-pressure governors in sizes and types for any application or special condition. For many years, the name LOMBARD has stood for *reliable service* and *closest regulation obtainable.*

THE LOMBARD GOVERNOR CO.
ASHLAND, MASS.

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TEMPERATURE INSTRUMENTS
INDICATING • RECORDING • CONTROLLING
There's a Tycos or Taylor Temperature Instrument for Every Purpose

If a *Tycos* tells it, it's accurate.

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Diesel builders since 1898
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Busch-Sulzer Bros-Diesel Engine Co
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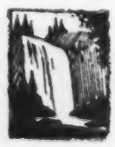
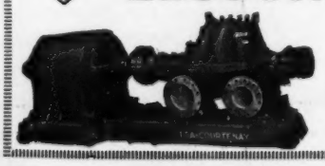


CONSULTATION with Woodward engineers and the installation of Woodward Governors will result in the turbines being controlled with entire satisfaction.
"Write for catalogue M"

WOODWARD GOVERNOR CO., Rockford, Ill.

WOODWARD
WATER WHEEL
GOVERNORS

LC LECOURTENAY LC



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LECOURTENAY CO.
26 MAINE STREET
NEWARK, NEW JERSEY

"Wonder" Cold Pipe, Tubing and Bar Benders
Standard of the World
HAND AND MOTOR OPERATED
14 Sizes of Machines
What it costs to bend pipe our way. Per Bend:
1-in. pipe, 5 cents 4-in. pipe, 25 cents
2-in. pipe, 10 cents 6-in. pipe, 60 cents
8-in. pipe, $1.00

Send for Catalogue
American Pipe Bending Machine Co.
28 Pearl St., Boston, Mass. *One Year to Pay*

Not just cranes . . .

but material moving systems

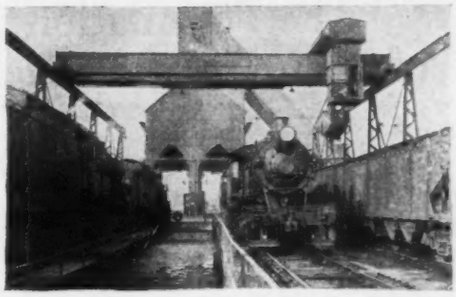
The moving of materials is not always a matter of weight, size or shape. Neither can it always be settled in the best way by simply ordering one or more cranes.

We have encountered so many problems in the handling of materials that out of our experience we can devise ways and means of handling that are exactly suited to the job.

For example, the handling of hot ashes from locomotives, the cooling of the ashes, the loading of the cars has been arranged in a very economical way for a big railroad. A Niles Crane system was made specially for this.

Another remarkable job is the handling of bricks shown in the photograph.

Let us help you to do the planning. If you have any problem involving the use of cranes, we urge you to send for a Niles Crane engineer. Get the benefit of all he knows at no cost to you. Write for him.



Grab Bucket Ash-handline Niles Crane
Philadelphia and Reading Railway, Reading, Pa.
Span of 56'-6" Bucket capacity 4 tons

This is the latest, the most modern efficient way to transport bricks. A Niles Gantry Crane is a vital part of the system

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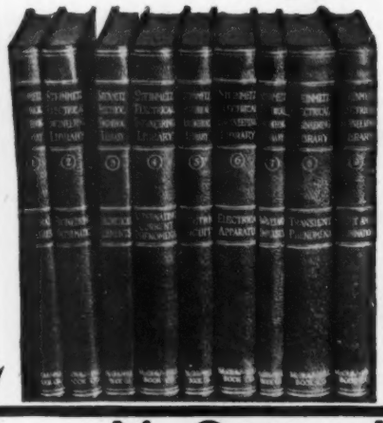

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Electric Bond and Share Company

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Paid-up Capital and Surplus, $100,000,000

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BECAUSE of the unusual variety of facilities required in a plant of this type, Newport News builds as painstakingly on small works as on the greatest power projects. We solicit inquiry from engineers building small as well as large hydro-electric developments.

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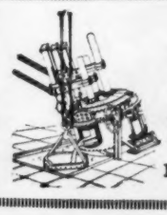
will
Build Power Business
for
THE CENTRAL STATION
Let us help increase your revenue
Detroit Electric Furnace Co.
2231 PARK BLVD., DETROIT



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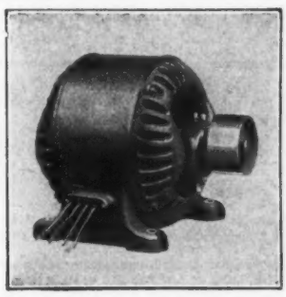
Ten Standard Sizes ½ to 24 Tons Capacity
Most Rapid and efficient for making
Tool Steels, Alloy Steels, Forging Steels
Steel Castings, Malleable Iron, Grey Iron
Carbide, Ferro-Alloys etc.
PITTSBURGH ELECTRIC FURNACE CORPORATION
P.O. Box 1125. PITTSBURGH, PA.

"300% Full Load Torque on Start, Bah" —snorted J. I. Gloom



"How can a motor give 300% full load torque at the start with only 250% full load current? It just ain't so." Old man Gloom thought he had us that time.

Again we packed up the necessary instruments, and gave the old pessimist a demonstration in his own shop. Again he was obliged to admit that he was convinced.

The Peerless Repulsion Induction Motor will pull an enormous load on start, yet the starting current is strictly limited. They are designed to absolutely prevent any sudden heavy inrush of current. No disturbance of line current, or overloading is possible, no matter how many of them are on your lines.

Point for point, Peerless Repulsion Induction Motors are superior. So are Peerless Polyphase and D. C. Motors.

Peerless motors are made in sizes from ¼ to 7½ H. P. and for all standard frequencies and voltages. The line is plenty wide for all ordinary conditions. Where special conditions are met, we can design a special motor to meet them. Our engineering department is at your service.

Peerless Motor Features

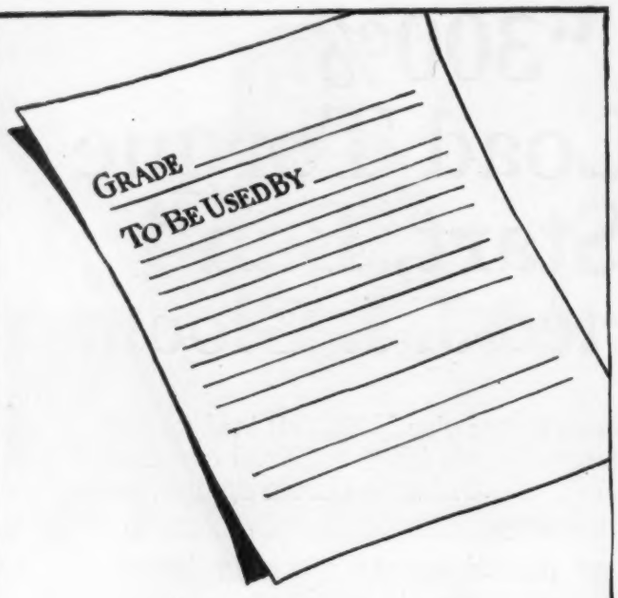
1. ***Automatic Self*** **starting under full load, with low inrush current.**
2. ***Pick Up*** **to full speed in 10 to 15 seconds.**
3. ***Carry Full Rated*** **load continuously with temperature rise not to exceed 40° Centigrade.**
4. ***Will Carry 100% Overload*** **for reasonable time without dropping out of step.**
5. ***Spring Barrel Assembly*** **which works positively, smoothly, and is trouble proof, results in "Peerless" motors having later breakdown point and showing flatter speed curve than any other motor of its type.**
6. ***Safe Governor*****—housed in safely by a flange on armature end-plate; each part in the assembly held securely in place by the part surmounting it.**
7. ***Rigid Perfectly Insulated*** **Commutator withstands higher speed test than we have been able to give it. Wonderfully insulated—absolutely rigid.**
8. **POWER FACTOR—Very high—efficiency high at all loads.**

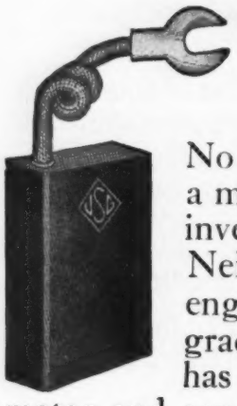
The Peerless Electric Co.
WARREN, OHIO

FANS—MOTORS—GENERATORS

Peerless

MOTORS





Prescription Blanks

No doctor recommends a medicine until he has investigated conditions. Neither does the U. S. G. engineer recommend the grade of brush until he has information on the motor and conditions under which it is to be used.

For this reason it is necessary to have your load and service information before fitting brushes to a motor. Then when U. S. G. Brushes are installed they are guaranteed to give you the best possible service. Try this specialized service on one of your troublesome motors. It costs you nothing. Write now.

BRUSHES

The United States Graphite Co.
Saginaw, Mich.

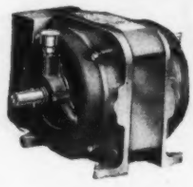
New York Philadelphia St. Louis Pittsburgh San Francisco Chicago

NEW BALDOR

TYPE C SINGLE PHASE MOTORS

Constant or Adjustable. Varying Speed.
1/10 to 1/2 hp. Light Starting Duty.

Quiet
Compact
Ball Bearing
No Brushes
No Commutator
No Centrifugal Switch



High efficiency
High power factor
Low starting current
Low running current
Low temperature rise.

Our Bulletin No. 10 of interest to user, appliance manufacturer and central station.

BALDOR ELECTRIC COMPANY
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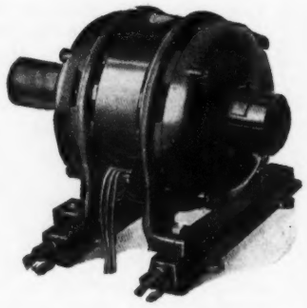
BALDOR
A BETTER MOTOR

BUY

NORTHWESTERN

QUIET RUNNING

MOTORS



"No Motors but good motors"

Northwestern induction motors are built right for severe service conditions. They are either constant speed or variable speed slip ring type. Their simple, rigid construction fit them to meet exacting demands. They will stand 25 per cent overload for two hours without exceeding a 55 degree rise.

Let us send you complete descriptions and prices. See why Northwestern can sell you motors that are designed right and will give you even more than the service you expect.

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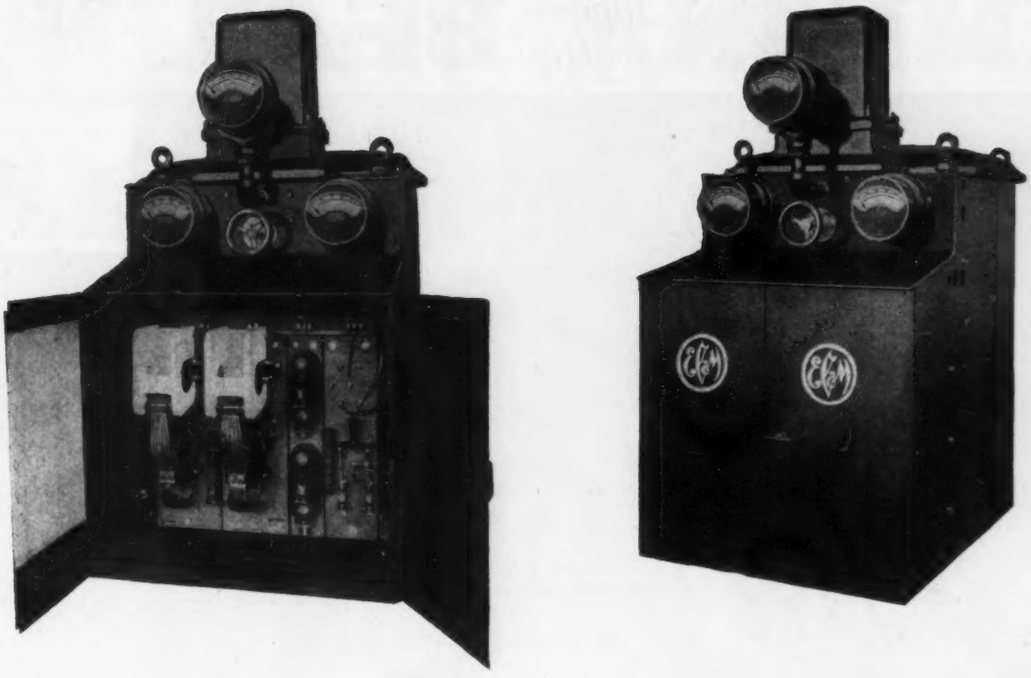

Both ends of an M-G set controlled by this enclosed, dust-proof unit

The EC&M idea in designing control equipment is to combine into a single unit all of the apparatus required to control and protect the machine with which it is used.

The illustrations show a dust-proof automatic starter for a 75 HP, 2300 volt motor which drives a 50 KW, 115 volt generator, providing excitation for synchronous motors in a cement mill.

The starting equipment for the motor end is oil-immersed. The generator panel is in a dust-proof cabinet built integral with the oil tank. Conduit connection is provided in separate compartments for high voltage A. C., low voltage A. C. (for control circuits) and the D. C. circuits.

There is a large saving in installation costs due to elimination of costly switchboards, bus bar supports, mounting and wiring of instrument transformers and other units. Expensive control rooms, in most cases, will not be required.

Consult EC&M for up-to-date control equipment

THE ELECTRIC CONTROLLER & MFG. CO.

CLEVELAND, OHIO

NEW YORK-50 CHURCH ST. CHICAGO-CONWAY BLDG. DETROIT-DIME BANK BLDG. BIRMINGHAM-BROWN-MARX BLDG. CINCINNATI-1ST NATIONAL BANK BLDG.
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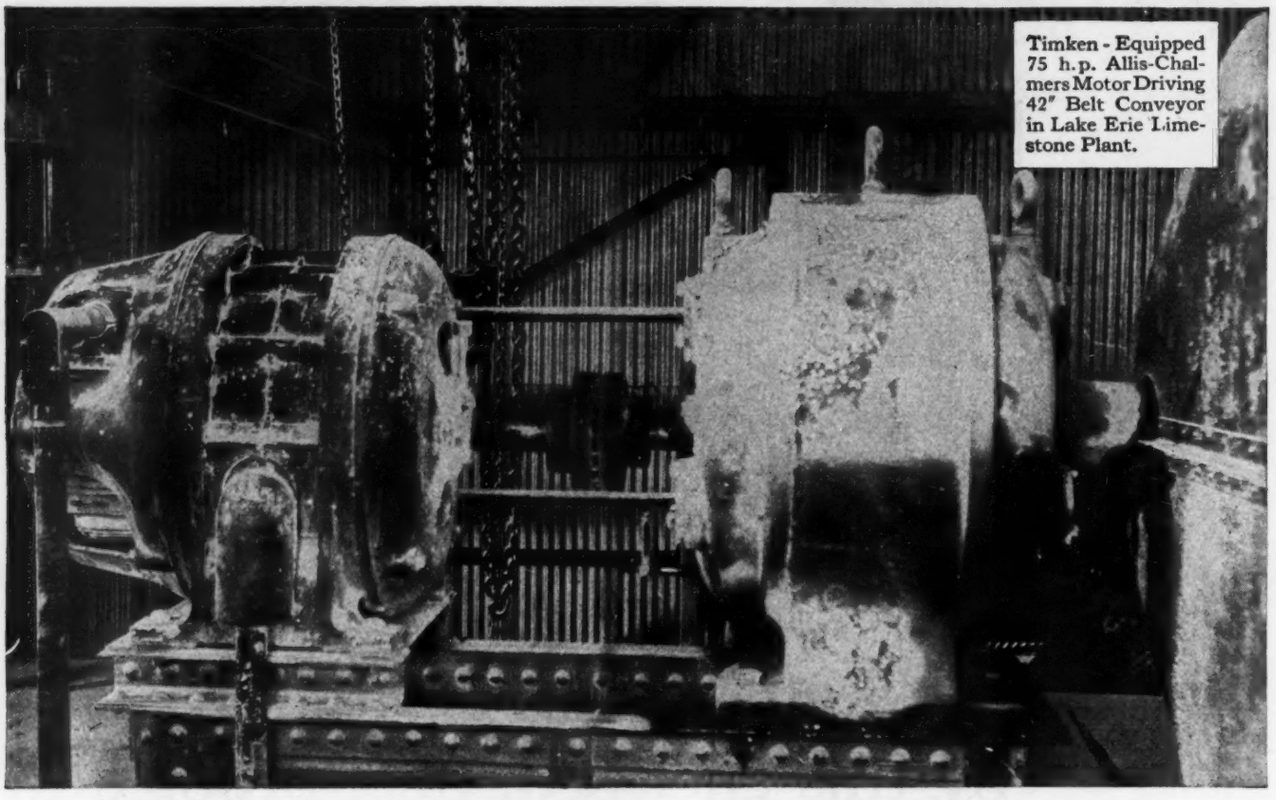
TIMKEN *Tapered Roller* BEARINGS



Timken-Equipped 75 h.p. Allis-Chalmers Motor Driving 42" Belt Conveyor in Lake Erie Limestone Plant.

Timken-Equipped Motors

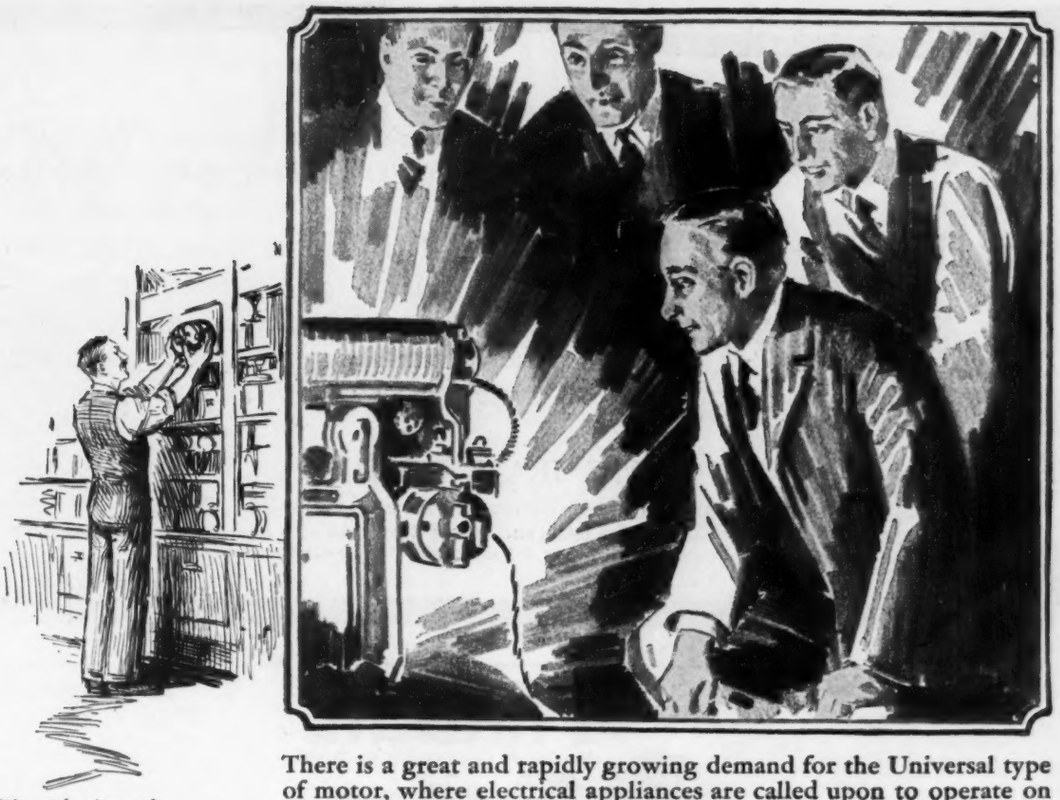
Down in the dust of limestone plants, in the heat of steel mills, in the muck of sewer tunnels, in the big, tough jobs where there is no mercy for motors, the value of Timken Tapered Roller Bearings is being recorded. The greatest motor endurance and economy ever known are being attained by means of Timken friction-elimination, Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken electric bearing steel.

There is no other way of carrying speed, thrust, shock, and highest radial load so simply and compactly. Shafts are shorter, rigidity is greater. Bearing housings are smaller, ventilation is better. Starting and operating characteristics improve. Type of drive and motor position can be disregarded—Timkens always work equally well—no alterations. And it takes only a negligible amount of lubrication to maintain Timken-equipped motors.

Wear, shutdowns and replacements are permanently warded off when Timken-equipped motors are specified.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

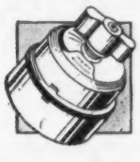
On a Shelf lay the *Solution* of his Problem!



TO simplify production and cut costs, the builder of a household appliance wished to replace with a Universal motor, the split-phase type he had been using. Samples had been wound and tried, but failed under test.

Still the manufacturer's engineers believed a Universal motor that met all requirements could be developed. On a shelf in their own laboratory they found one day an old Domestic Universal motor, and decided to experiment for themselves.

Their random selection so nearly met the requirements that the Domestic Electric Co., was called in. Domestic made electrical and mechanical modifications to fit the particular application—and today numbers this manufacturer among its most valued customers.



For protection from overload—the Domestic Automatic Safety Switch.

There is a great and rapidly growing demand for the Universal type of motor, where electrical appliances are called upon to operate on different currents and under varying loads.

When correctly designed, correctly built, correctly applied, the Universal motor meets many requirements of service that other types cannot meet. It is dependable—flexible—efficient—economical.

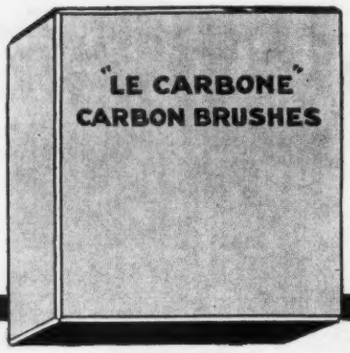
A correct application of the Universal motor often simplifies the appliance builder's production problem—and cuts his costs. It allows appliance dealers to carry in stock only one type of motor and one assembly, regardless of the kind of current used.

The Domestic Electric Company, a pioneer in the development of the Universal motor, has for many years analyzed its possible fields of usefulness and the variations of design required for specific applications.

Our engineers bring to appliance manufacturers an experience that is unique in the fractional horsepower field. Let them study your motor problems—operating as a department of your business would operate—and make recommendations.

THE DOMESTIC ELECTRIC COMPANY
7209-25 St. Clair Avenue CLEVELAND, OHIO

Domestic
"INDUSTRY'S BIGGEST LITTLE THING!"
Electric Motors
FRACTIONAL HORSEPOWER

Why 

"Le Carbone" Carbon Brushes?

Reason No. 4

They talk for themselves

They are absolutely uniform. You could break 10,000 of them and not find the slightest variation in their texture. And you would find no variation if you tested these brushes for electrical characteristics. That means unvarying efficiency in the commutation of your generators, motors and rotors.

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Factory Terminal Bldg., Fifteenth Street, Hoboken, N. J.
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SMITH & SERRELL
24 Washington Place
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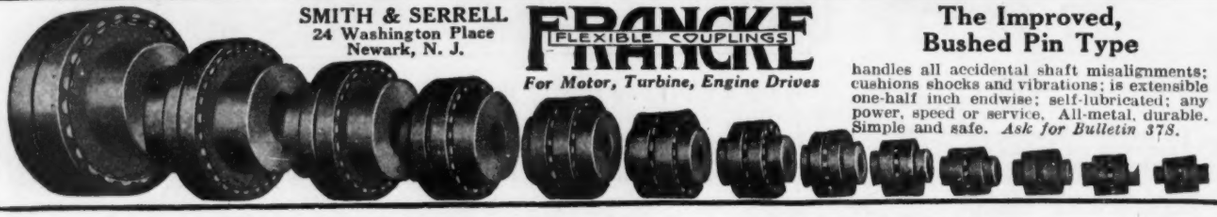
FRANCKE FLEXIBLE COUPLINGS
For Motor, Turbine, Engine Drives



The Improved, Bushed Pin Type
handles all accidental shaft misalignments; cushions shocks and vibrations; is extensible one-half inch endwise; self-lubricated; any power, speed or service. All-metal, durable. Simple and safe. *Ask for Bulletin 378.*

SUNDH *Electric Co.*

Automatic Starters
Circuit Breakers
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Magnet Switches
Pressure Regulators
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Class 8605
Compensator
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Industrial Controller Co.
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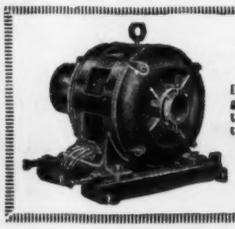
THE MOST COMPLETE LINE OF BALL BEARINGS TYPES AND SIZES IN AMERICA
FAFNIR
TRANSMISSION EQUIPMENT
THE FAFNIR BEARING CO. NEW BRITAIN, CONN.

Reliance Electric & Engineering Co., 1046 Ivanhoe Rd., Cleveland, O.



STAR
Ball Bearing Motors
Direct and Alternating Current up to 75 hp. Also generators and alternators in horizontal and vertical types, and motor generator sets. We build motors to meet your requirements. *Ask for more data.*
Star Electric Motor Co.
Miller St. and N. J. R. R. Ave.,
Newark, N. J.

WARD LEONARD Vitrohm Theatre Dimmers control lighting completely, easily, and accurately.

The more than 35 years of manufacturing experience back of Vitrohm Dimmers contribute in no small measure to their many superior features.

That Ward Leonard is constantly looking ahead to anticipate every lighting control need of the Theatre Industry is assured by constant research and an honest endeavor to make each installation of Vitrohm Dimmers an example of Ward Leonard craftsmanship and engineering.

Ward Leonard Electric Company

31-41 South Street Mount Vernon, N. Y.

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Equipment, Apparatus and Supplies Advertised in This Issue with Names of Manufacturers

Readers interested in any articles not listed in these pages are cordially invited to inform us of their wants and every effort will be made to put them in touch with the proper manufacturers.

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Ohio Brass Co.
Westinghouse Elec. & Mfg. Co.

Armature Repair Machinery
Electric Service Supplies Co.

Asbestos
Johns-Manville Corp.

Ash Conveyors
Combustion Engr. Co.

Babbitts
Westinghouse Elec. & Mfg. Co.

Batteries, Dry
Western Electric Co.

Batteries, Storage
Electric Storage Battery Co.

Battery Charging Apparatus
Cutler-Hammer Mfg. Co.
General Electric Co.
Wagner Electric Corp.
Ward Leonard Electric Co.
Westinghouse E. & M. Co.

Bearings
Ball
Fafnir Bearing Co.
Roller
Timken Roller Bearing Co.
Thrust
S. Morgan Smith Co.

Bells, Conduit
G. & W. Electric Spec. Co.

Blocks, Fuse
Westinghouse Elec. & Mfg. Co.

Blowers
Sturtevant Co., B. F.

Boiler Room Instruments (See Instruments)

Boilers
Waste Heat
Combustion Engr. Corp.
Ladd Water Tube Boiler Co.
Water Tube
Babcock & Wilcox Co.
Combustion Engr. Corp.
Ladd Water Tube Boiler Co.

Bolts
Carriage
Hubbard & Co.
Crossarm
Hubbard & Co.
Expansion
Hubbard Co.
Machine
Hubbard & Co.

Bonds, Rail
Ohio Brass Co.

Books, Technical
McGraw-Hill Book Co., Inc.
McGraw-Hill Catalog & Directory, Co., Inc.

Boosters
Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse E. & M. Co.

Boxes
Fuse
General Electric Co.
Schweitzer & Conrad, Inc.
Junction and Outlet
General Electric Co.
Westinghouse E. & M. Co
Meter and Service
General Electric Co.

Braces, Crossarm
Bates Steel Corp., Walter
Hubbard & Co.

Brackets and Pins, Metal
Hubbard & Co.

Brakes, Electric
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.

Brushes
Carbon
United States Graphite Co.
Dynamo and Carbon
Jeandron, W. J.
Motor and Generator
United States Graphite Co.

Buckets
Mead-Morrison Mfg. Co.

Buckets, Clamshell
Blaw-Knox Co.

Buildings, Steel
Bates Steel Corp., Walter
Blaw-Knox Co.

Bus Bar Supports
Electric Power Equip. Corp.
General Electric Co.
Ohio Brass Co.
Railway & Indus. Eng. Co.
Schweitzer & Conrad, Inc.
Westinghouse E. & M. Co.

Bus Bars and Bus Tubes
American Brass Co.

Bushings, Porcelain
Ohio Brass Co.

Cable (See Wires & Cables)

Cable Accessories, End Bells and Racks
Electrical Engineers' Equip. Co.
General Electric Co.
Hubbard & Co.
Philadelphia Elecl. & Mfg. Co.
Standard Underground Cable Co.

Cable and Splicing Material
G. & W. Elec. Spec. Co.

Cable Boxes, Underground
G. & W. Electric Spec. Co.

Cabling Machinery
American Ins. Machy. Co.

Caps, Ground
Hubbard & Co.

Carbon Products
United States Graphite Co.

Catenary Trolley Materials
Ohio Brass Co.

Cell Structures
Deceleco, Inc

Cement, High Temperature
Johns-Manville Corp.

Circuit Breakers
Anderson Mfg. Co., A. & J. M.
Condit Elec'l Mfg. Corp.
General Electric Co.
Roller-Smith Co.
Schweitzer & Conrad, Inc.
Sundh Electric Co.
Ward Leonard Electric Co.
Westinghouse E. & M. Co.
Air
Cutter Co.
Enclosed Air
Cutter Co.

Clamps
Cable, Supporting
Matthews Corp., W. N.
Ground Connection
Railway & Industrial Engr. Co.
Sherman Mfg. Co., H. B.
Guy
Hubbard & Co.
Matthews Corp., W. N.
Trolley
Ohio Brass Co.
Wire
Wire-Lock Clamp Co.

Cleats
Blake Signal & Mfg. Co.
Imperial Porcelain Co.
Thomas & Sons Co., R.

Clevises
Hubbard & Co.

Clips
Cable
Hubbard & Co.
Pittsburgh Transformer Co.

Clutches, Magnetic
Cutler-Hammer Mfg. Co.

Coal and Ash Handling Machinery
Combustion Engineering Co.

Coils
Choke
General Electric Co.
Ry. & Industrial Eng. Co.
Schweitzer & Conrad, Inc.
Westinghouse E. & M. Co.

Compensators
Electric Controller & Mfg. Co.

Compressors, Air
Worthington Pump & Machy. Corp.

Condensers
Static
Westinghouse Elec. & Mfg. Co.
Steam
Allis-Chalmers Mfg. Co.
General Electric Co.
Ingersoll-Rand Co.
Westinghouse E. & M. Co.
Worthington Pump & Machy. Corp.

Condenser Tubes
American Brass Co.

Conduits, Fibre
Fibre Conduit Co.
Johns-Manville Corp.

Conduits, Interior
Johns-Manville Corp.

Conduits, Underground
Fibre Conduit Co.
Johns-Manville Corp.

Conduits, Flexible, Steel, Rigid
General Electric Co.

Conduit, Rigid, Aluminum
Aluminum Co. of America

Connectors and Terminals
Electric Power Equip. Corp.
General Electric Co.
Railway & Industrial Engr. Co.
Sherman Mfg. Co., H. B.
Westinghouse E. & M. Co.

Connectors, Solderless Service
Kearney Corp., James R.

Contact Points
Baker & Co., Inc.

Contactors
Electric Controller & Mfg.

Contact Rail Material
Electric Service Supplies Co.
Ohio Brass Co.

Control, Electric Valve
Cutler-Hammer Mfg. Co. (Dean)

Control, Railway
Westinghouse Elec. & Mfg. Co.

Control Systems
Electric Controller & Mfg Co.
Ward Leonard Electric Co.

Controllers
Automatic
Cutler-Hammer Mfg. Co.
Ward Leonard Electric Co.
Crane
Electric Controller & Mfg. Co.
Motor
General Electric Co.
Industrial Controller Co.
Sundh Electric Co.
Union Electric Mfg. Co.
Ward Leonard Electric Co.
Westinghouse E. & M. Co.
Pheostatic
Ward Leonard Electric Co.
Speed
Ward Leonard Electric Co.

Converters
Booster
Allis-Chalmers Mfg. Co.
Westinghouse Elec. & Mfg. Co
Rotary
Wagner Electric Corp.
Synchronous
Westinghouse Elec. & Mfg. Co.

Conveyors, Belt
Sturtevant Co., B. F.

Coolers, Generator
Sturtevant Co., B. F.

Cord
Arc Lamp
Samson Cordage Works
Flexible
Simplex Wire & Cable Co.
Portable, Rubber Covered
Simplex Wire & Cable Co.
Trolley
Samson Cordage Works

Cords and Cables, Flexible
Okonite Co.
Simplex Wire & Cable Co.

Couplings, Flexible
Smith & Serrell

Couplings, Rigid (Shaft)
Smith & Serrell

Crane Motors
General Electric Co.
Westinghouse E. & M. Co.

Cranes
Electric
Niles Crane Corp.
Shepard Elec. Crane & Hoist Co.
Traveling
Maris Bros.
Niles Crane Corp.
Shepard Elec. Crane & Hoist Co.

Cross-Arms
Hubbard & Co.
Philadelphia Elec'l & Mfg. Co.
Ry. & Industrial Eng. Co.
Thomas & Sons Co., R.
Western Electric Co.
Steel
Bates Steel Corp. Walter

Cutouts
General Electric Co.
Matthews Corp., W. N.
Westinghouse Elec. & Mfg. Co.
Plug
Kearney Corp., James R.
High Tension
Schweitzer & Conrad, Inc.
Series
G. & W. Elec. Spec. Co.
Transformer
Wagner Electric Corp.

Devices, Protective
Condit Elec'l Mfg. Corp.
Electric Power Equip. Corp
General Electric Co.
Roller-Smith Co.
Ry. & Industrial Eng. Co
Schweitzer & Conrad, Inc.
Westinghouse E. & M. Co.

Dimmers, Theatre
Ward Leonard Electric Co.

Doors for Bin and Switch Compartments
Deceleco, Inc.
Johns-Manville Corp.

Drills
Rock
Hubbard & Co
Ingersoll-Rand Co.

Economizers
Babcock & Wilcox Co.

Electric Railway Materials
Ohio Brass Co.

Electrification Materials, Steam Road
Ohio Brass Co.

Enameling Machinery, Wire
American Insulating Machinery Co.

Engineering Building & Equipment
Austin Co.

Engineers, Consulting (See Directory of Engineers)

Engines
Diesel
Busch-Sulzer Bros., Diesel Engine Co.
Lombard Governor Co.
Worthington Pump & Machy. Corp.
Gas
Allis-Chalmers Mfg. Co.
Worthington Pump & Machy. Corp.
Oil
Busch-Sulzer Bros., Diesel Engine Co.
Ingersoll-Rand Co.
Lombard Governor Co.
Steam
Allis-Chalmers Mfg. Co.

Equipment, High Tension
Ohio Brass Co.
Schweitzer & Conrad, Inc.

Equipment, Switching
Kearney Corp., James R.

Fan Motors
Century Elec. Co.
General Electric Co.
Rockbestos Products Co.
Western Electric Co.
Westinghouse E. & M. Co

Fans (Exhaust and Ventilating)
Century Electric Co.
Wagner Electric Corp.
Westinghouse E. & M. Co.

Fault Locators
Matthews Corp., W. N.

Fence, Woven Wire
Cyclone Fence Co.

Fibre
Continental Fibre Co.

Financial
Electric Bond & Share Co.
Foshay, W. B.

Flooring, Open Steel
Blaw-Knox Co.

Furnaces
Combustion Engr. Corp.

Furnaces, Electric
Pittsburgh Electric Furnace Corp.

Fuses
High Tension
Electrical Engineers Equip. Co.
General Electric Co.
Matthews Corp., W. N.
Schweitzer & Conrad Co.
Westinghouse Elec. & Mfg. Co.
Renewable
Westinghouse E. & M. Co.
Standard
Condit Elec'l Mfg. Corp.
General Electric Co.
Westinghouse E. & M. Co.

Galvanizing
Hubbard & Co.

Galvanizing, Hot Dip
Bates Expanded Steel Truss Co.
Bates Steel Corp., Walter
Lehigh Structural Steel Co.
Newport News Shipbuilding & Dry Dock Co.

Gates, Head and Sluice
Newport News Shipbuilding & Dry Dock Co.
S. Morgan Smith Co.

Guards, Lamp
Matthews Corp., W. N.

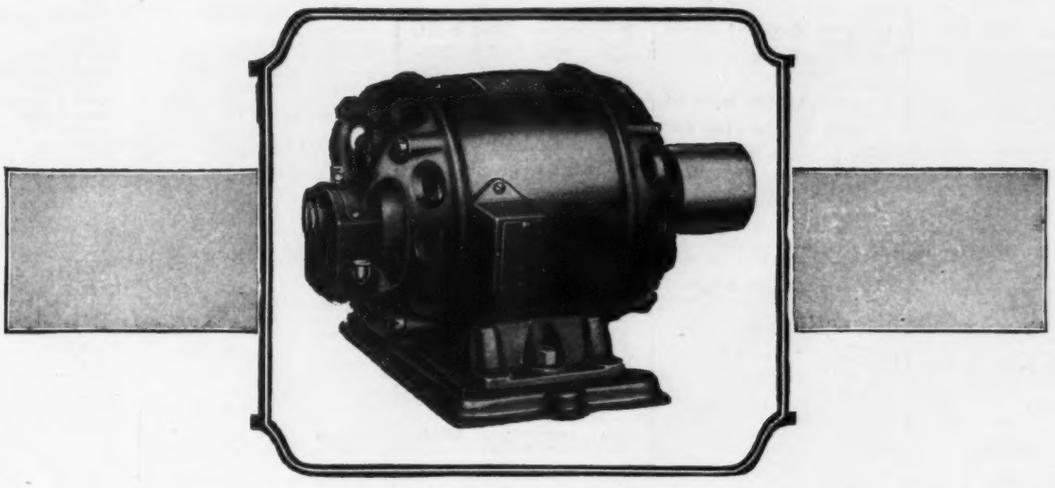
Gears
Continental Fibre Co.
Westinghouse Elec. & Mfg. Co.

Generators
Allis-Chalmers Mfg. Co.
Burke Electric Co.
Belt Driven
Westinghouse Elec. & Mfg. Co.
Engine Driven
Westinghouse Elec. & Mfg. Co.
Steam
Combustion Engr. Corp.
Waterwheel Driven
Westinghouse Elec. & Mfg. Co.

Generating Sets
General Electric Co.
Westinghouse E. & M. Co.
Direct Connected & Geared
Westinghouse Elec. & Mfg. Co.
Motor
Allis-Chalmers Mfg. Co.
Turbine Driven
Westinghouse Elec. & Mfg. Co.

Generator Sets
Wagner Electric Corp.

Governors, Water Wheel
Pelton Water Wheel Co.
Hydraulic
Woodward Governor Co.



¼ Horse Power Century Type RS Repulsion Start
Induction Single Phase Motor

Reliable Service

for Refrigerators, Oil Burners and House Pumps

The design and liberal mechanical proportions of Century Type RS Repulsion Start Induction Single Phase Motors assure quiet, carefree service over long periods of time under severe operating conditions. Some of the desirable features which contribute to their quiet, "Keep a-Running" ability are —

1 . . Rigid, and free from inherent vibration, due to liberal and scientific distribution of material.

2 . . No brush-friction noises. The brushes bear on the commutator only during the starting period . . . from 5 to 10 seconds, depending upon the connected load.

3 . . Static and running balance tests are applied to each armature, eliminating vibration to the greatest degree commercially practical.

4 . . The Century Wool-yarn System of Lubrication, standard on all one horse power and smaller Century Type RS Repulsion Start Induction Single Phase Motors, assures at least one year's continuous 24-hour-per-day operation without reoiling.

Built in all standard sizes from ⅛ to 40 horse power. Temperature rise not more than 40° Centigrade in the hottest spot.

CENTURY ELECTRIC CO. ' ' 1806 *Pine Street* ' ' ST. LOUIS

For More Than 23 Years at St. Louis

"They Keep ⅛ to 40 H. P.

Century MOTORS

a-Running" ⅛ to 40 H. P.

Mechanical
Woodward Governor Co.
Grounds, etc.
Copperweld Steel Co.
Paragon Electric Co.
Ground Caps
G. & W. Elec. Spec. Co.
Ground Rods, Galv., Copper
Hubbard & Co.
Hardware, Insulator
Ohio Brass Co.
Hardware, Pole Line
Ohio Brass Co.
Hangers
Cable
Hubbard & Co.
Headlights, Arc and Incandescent
Ohio Brass Co.
Heaters, Feed Water
Worthington Pump & Machy. Corp.
High Tension Materials
Ohio Brass Co.
High Voltage Glass
Corning Glass Works "Pyrex"
Heating Devices
Cutler-Hammer Mfg. Co.
General Electric Co.
Western Electric Co.
Hoists
Electric and Steam
Allis-Chalmers Mfg. Co.
Electrical
Shepard Elec. Crane & Hoist Co.
Head Gate
Newport News Shipbuilding & Dry Dock Co.
S. Morgan Smith Co.
Indicators, Speed (See Tachometers)
Indicators, Transformer Road
Westinghouse Elec. & Mfg. Co.
Instrument Transformers
General Electric Co.
Weston Elec'l Inst. Co.
Instrument Test Switches
Electrical Development & Mach. Co.
Instruments
Roller Room
General Electric Co.
Westinghouse E. & M. Co.
Electrical
Ferranti Meter & Trans. Mfg. Co., Ltd.
Roller-Smith Co.
Graphic
General Electric Co.
Taylor Instrument Co.
Indicating
General Electric Co.
Roller-Smith Co.
Taylor Instrument Co.
Westinghouse E. & M. Co.
Integrating
General Electric Co.
Westinghouse E. & M. Co.
Portable
Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.
Recording
Landis & Gyr, Ltd.
Westinghouse Elec. & Mfg. Co.
Scientific and Testing, Service
General Electric Co.
Roller-Smith Co.
Westinghouse E. & M. Co.
Weston Elec'l Inst. Co.
Transformer
General Electric Co.
Roller-Smith Co.
Insulating Machinery, Wire
American Ins. Machinery Co.
Insulating Material
Asbestos
Deceleco, Inc.
Johns-Manville Corp.
Cement
Mitchell-Rand Mfg. Co.
Compounds, Paints and Varnishes
General Electric Co.
Irvington Varnish & Ins. Co.
Mica Insulator Co.
Mitchell-Rand Mfg. Co.
Westinghouse E. & M. Co.
Comp. Cloth and Paper
General Electric Co.
Irvington Varnish & Ins. Co.
Mica Insulator Co.
Fibre
Continental Fibre Co.
National Vulc. Fibre Co.
Laminated Phenolic Condensation Products
Continental Fibre Co.
Lava
American Lava Corporation
Steward Mfg. Co., D. M.
Westinghouse Elec. & Mfg. Co.
Mica
Eugene Munsell Co.
Molded
Bakelite Corp.
Cutler-Hammer Mfg. Co.
Garfield Mfg. Co.
Johns-Manville Corp.
Paper
Irvington Varnish & Ins. Co.
Porcelain
Mica Insulator Co.
Ohio Brass Co.
Silk
Irvington Varnish & Ins. Co.
Slate
Portland Monson Slate Co.
Tape
Mica Insulator Co.
Tape and Webbing
General Electric Co.
Okonite Co., The
Transite
Deceleco, Inc.
Treated Fabrics & Paper
Westinghouse Elec. & Mfg. Co.
Untreated Fabrics & Paper
Westinghouse Elec. & Mfg. Co.
Insulation, Electric
Bakelite Corp.
Insulators
China, Porcelain & Composition
Mica Insulator Co.
High Voltage Porcelain
Electric Service Supplies Co.
Franklin Porcelain Co.
Lapp Insulator Co., Inc.
Ohio Brass Co.
Glass
Hemingray Glass Co.
Lapp Insulator Co., Inc.
Pin Type
Railway & Industrial Engr. Co.
Porcelain, Composition
General Electric Co
Imperial Porcelain Works
Jeffery Dewitt Ins. Co.
Lapp Insulator Co., Inc.
Ohio Brass Co.
Thomas & Sons Co., R.
Westinghouse Elec. & Mfg. Co.
Porcelain
Canadian Porcelain Co., Ltd.
Ohio Brass Co.
Insulator Pins
Ohio Brass Co.
Philadelphia Elecl. & Mfg. Co.
Thomas & Sons Co., R.
Insulator, Pin Type
Ohio Brass Co.
Irons, Electric
Westinghouse E. & M. Co.
Laminated Phenolic Condensation Products
Bakelite Corp.
Lamp Replacers
G. C. A. Mfg. Co.
Lamps
Arc
General Electric Co.
Westinghouse E. & M. Co.
Cable Supporting
Matthews Corp., W. N.
Incandescent
General Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.
Miniature, Inc.
General Electric Co.
Lighting Equipment, Interior and Exterior
Hubbard & Co.
Philadelphia Elec'l. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Lighting Fixtures, Industrial
Philadelphia Elecl. & Mfg. Co.
Lighting Standards
Bates Steel Corp., Walter
Philadelphia Electrical & Mfg. Co.
Truscon Steel Corp.
Lightning Arresters
Electric Power Equip. Corp.
Electric Service Supplies Co.
Electrical Engineers' Equip Co.
General Electric Co.
Hubbard & Co.
Ry. & Industrial Eng. Co.
Schweitzer & Conrad, Inc.
Westinghouse E. & M. Co.
Line Material
Electric Service Supplies Co.
General Electric Co.
Hubbard & Co.
Ohio Brass Co.
Westinghouse E. & M. Co.
Lineman's Safety Platform
Hubbard & Co.
Linemen's Supplies & Tools
Leach Co.
Locomotives, Electric
Westinghouse Elec. & Mfg. Co.
Lubricants
Vacuum Oil Co.
Lugs
Sherman Mfg. Co., H. B.
Machinery, Mining
Allis-Chalmers Mfg. Co.
Machines, Pipe Bending
American Pipe Bending Machine Co.
Machines, Welding
Westinghouse Elec. & Mfg. Co.
Magnets
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
Magnets, Lifting
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
Meter Testers
General Electric Co.
Westinghouse E. & M. Co.
Meters
Demand
Landis & Gyr, Ltd.
Westinghouse Elec. & Mfg. Co.
Kilovolt Amperes
Landis & Gyr, Ltd.
Westinghouse Elec. & Mfg. Co.
Watthour
Duncan Elec. Mfg. Co.
Landis & Gyr, Ltd.
Westinghouse Elec. & Mfg. Co.
Meters, Flow (See Instruments, Electric and Boiler Room)
Mica
Eugene Munsell Co.
Molded Insulation (See Insulation, Molded)
Molded Parts
Garfield Mfg. Co.
Molding Materials
Bakelite Corp.
Motors
Allis-Chalmers Mfg. Co.
Baldor Electric Co.
Burke Elec. Co.
Century Electric Co.
General Electric Co.
Graybar Electric Co.
Imperial Electric Co.
Lincoln Electric Co.
Marble-Card Elec. Co.
Rockbestos Products Co.
Sturtevant Co., B. F.
Wagner Electric Corp.
Zobell Elec. Motors Co.
Mine
Westinghouse Elec. & Mfg. Co.
Railway
Westinghouse Elec. & Mfg. Co.
Small
Domestic Electric Co.
Westinghouse E. & M. Co.
Motor Generators
Westinghouse Elec. & Mfg. Co.
Motor Generator Sets
Burke Elec. Co.
Oil and Grease, Lubricating
Vacuum Oil Co.
Oil Burners
Babcock & Wilcox Co.
Combustion Engr. Corp.
Oil Engines (See Engines)
Oil Separators and Purifiers
De Laval Separator Co.
Hydroil Sales Corp.
Overhead Line Materials
Ohio Brass Co.
Packing, Asbestos
Johns-Manville, Inc.
Painting Equip. Mech. or Elec'l.
Matthews Corp., W. N.
Panel Boards
General Electric Co.
Trumbull Elec. Mfg. Co.
Panels, Switchboard
Allis-Chalmers Mfg. Co.
General Electric Co.
Pavement Breakers, Pneumatic
Ingersoll-Rand Co.
Pencils, Drafting
American Lead Pencil Co.
Phantom Loads
States Co., The
Pins, Insulator
Hubbard & Co.
Ohio Brass Co.
Pipe
Riveted Steel
Newport News Shipbuilding & Dry Dock Co.
Riter-Conley Mfg. Co.
Pipe Frame Fittings, Elec'l
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.
Platinum
Baker Platinum Works
Plugs
General Electric Co.
Westinghouse E. & M. Co.
Attachment
Cutler-Hammer Mfg. Co.
General Electric Co.
Pole Line Hardware
Electric Service Sup. Co.
Hubbard & Co.
Ohio Brass Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.
Poles
Cedar
Bell Lumber Co.
Carney & Co., B. J.
Chestnut
Frankfort Lumber Co.
Creosoted Southern Pine
Texas Creosoting Co.
Western Electric Co.
Iron
Archbold-Brady Co.
Steel
Aermotor Co.
Archbold-Brady Co.
Bates Expanded Steel Truss Co.
Bates Steel Corp., Walter
Lehigh Structural Steel Co.
Milliken Bros. Mfg. Co.
Riter-Conley Mfg. Co.
Truscon Steel Co.
Wood
American Creosoting Co.
Poles, Reinforcing of
Hubbard & Co.
Porcelain
Electrical Porcelain Mfrs. Assn.
Potentiometers
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Potheads
G. & W. Elec. Spec. Co.
Ohio Brass Co.
Railway & Industrial Engr. Co.
Preheaters, Air
Babcock & Wilcox Co.
Projectors, Floodlighting
Elec. Service Supplies Co.
Westinghouse Elec. & Mfg. Co.
Pullers, Car
Mead-Morrison Mfg. Co.
Pullers, Slack
Matthews Corp., W. N.
Pulverized Fuel Equipment
Aero Pulverizer Co.
Combustion Engineering Co
Pumping Systems, Air Lift
Ingersoll-Rand Co.
Pumps
Pelton Water Wheel Co.
Worthington Pump & Machy. Corp.
Boiler Feed
Cameron Steam Pump Works, A. S.
Ingersoll-Rand Co.
Lecourtenay Co.
Centrifugal
Allis-Chalmers Mfg. Co.
Cameron Steam Pump Works, A. S.
Ingersoll-Rand Co.
Lecourtenay Co.
Power
Lecourtenay Co.
Reciprocating
Allis-Chalmers Mfg. Co.
Pyrometers
Taylor Instrument Co.
Racks, Cable
G. & W. Elec. Spec. Co.
Racks, Secondary
Hubbard Co.
Truscon Steel Co.
Radio Apparatus
Cutler-Hammer Mfg. Co.
General Electric Co.
Westinghouse E. & M. Co.
Rail Bonds
American Steel & Wire Co.
Ohio Brass Co.
Rake, Rack
Newport News Shipbldg. & Drydock Co.
Ranges, Electric
Westinghouse Elec. & Mfg. Co.
Rectifiers
General Electric Co.
Wagner Electric Corp.
Westinghouse E. & M. Co.
Reels, Take-Up and Pay-Out
Matthews Corp., W. N.
Reflectors
Philadelphia Elecl. & Mfg. Co.
Refrigerators
Frigidaire Corp.
General Electric Co.
Regulators, Feedervoltage
Westinghouse Elec. & Mfg. Co.
Relays
Condit Elec'l Mfg. Corp.
Electric Controller & Mfg. Co.
Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.
Repairing (See Searchlight Section)
Replacers, Lamp
Matthews Corp., W. N.
Resistance Loads
States Co., The
Resistance Units
Cutler-Hammer Mfg. Co.
General Electric Co.
Ry. & Industrial Eng. Co
Ward Leonard Electric Co.
Resistors
Electric Controller & Mfg. Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.
Rheostats
Cutler-Hammer Mfg. Co.
General Electric Co.
Sundh Electric Co.
Ward Leonard Electric Co.
Rings, Cable
Hubbard & Co.
Screws, Lag
Hubbard & Co
Searchlights
General Electric Co.
Second-Hand Apparatus (See Searchlight Section)
Archer & Baldwin, Inc.
Belyea Co., Inc.
Berger Bros.
Cutter, F. B.
Electric Service Co. (Watervliet, N. Y.)
Electric Service Co., Inc., Cincinnati, O.
Electrical Repair & Equip. Co.
Gregory Electric Co.
Hall & Co., Inc., Stephen
Hemphill & Co., J. L.
Kansas City Power & Light Co.
Land, L. J.
Lepper, C. W.
Nashville Industrial Corp.
Nussbaum Co., V. M.
Phoenix Utility Co.
Randle Machinery Co.
Ross Power Equip. Co.
Sachsenmaier Co., George
Scheinert Co., R.
Skeldan Engr. Co.
Stone & Webster, Inc.
Separators, Magnetic
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
Sheets
Copper, Brass, Bronze and Nickel Silver
American Brass Co.
Electrical
Central Alloy Steel Corp.
Slate
Portland Monson Slate Co.
Sockets and Receptacles
Cutler-Hammer Mfg. Co.
General Electric Co
Philadelphia Elecl. & Mfg Co.
Solders
Mitchell-Rand Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Soldering Flux
Mitchell-Rand Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Soldering Irons
Cutler-Hammer Mfg. Co.
Solenoids
Electric Controller & Mfg. Co.
Solenoids (See Coils)
Standards, Lighting
Truscon Steel Co.
Staples
Hubbard & Co.
Staples, Insulated
Blake Signal & Mfg. Co.
Starters, Motor, Electric
Condit Elec'l Mfg. Corp.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
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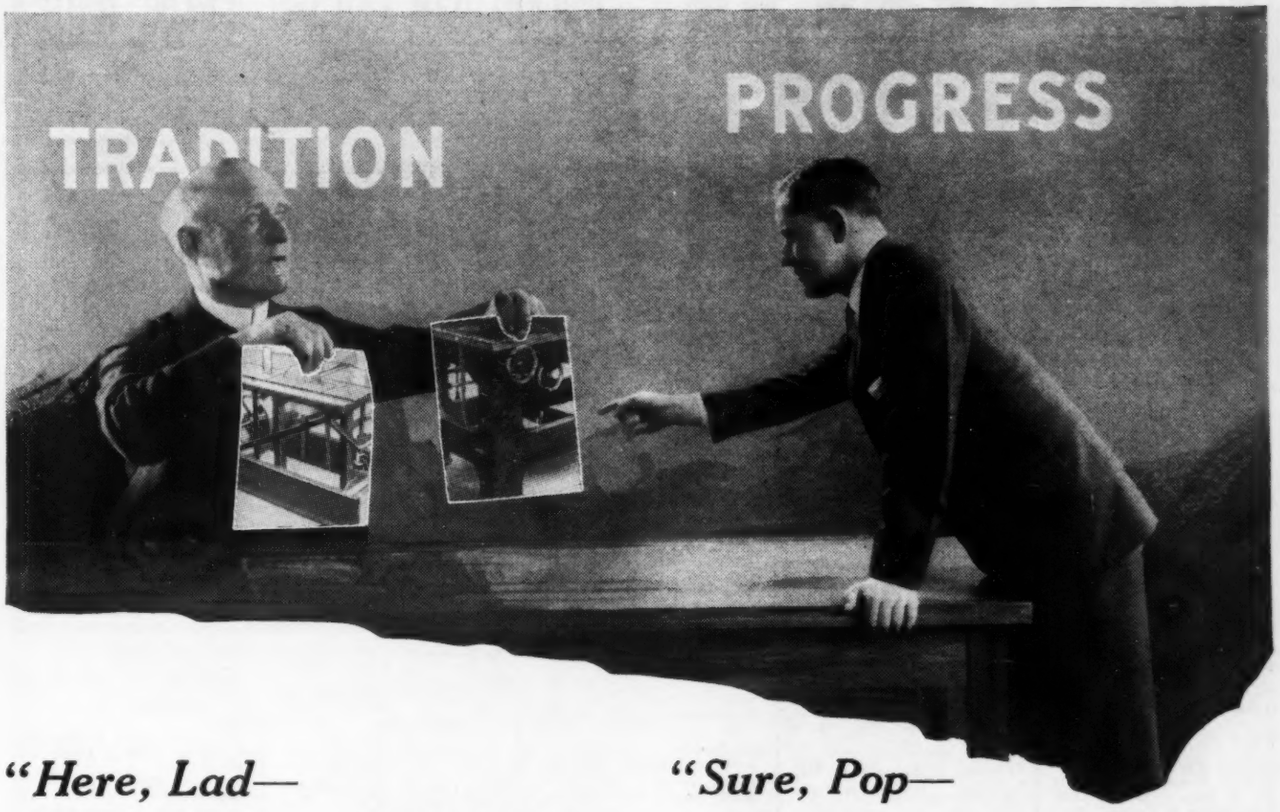

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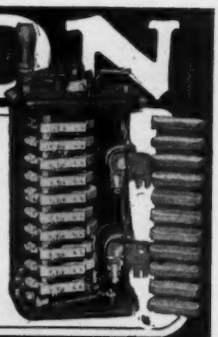

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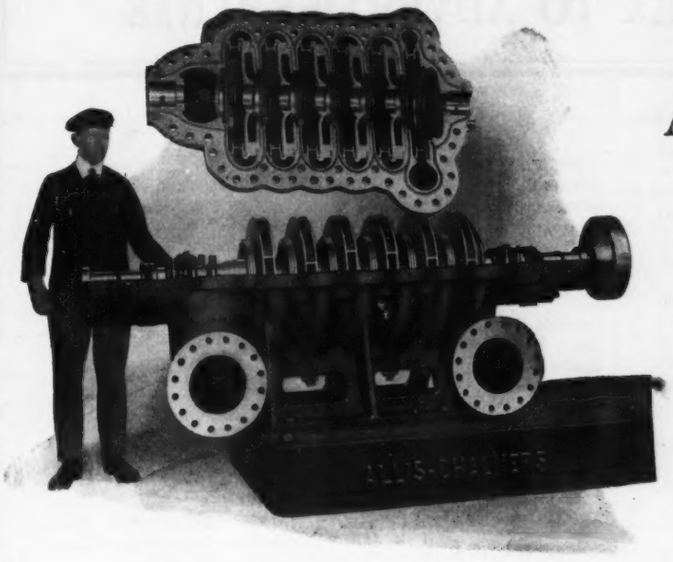

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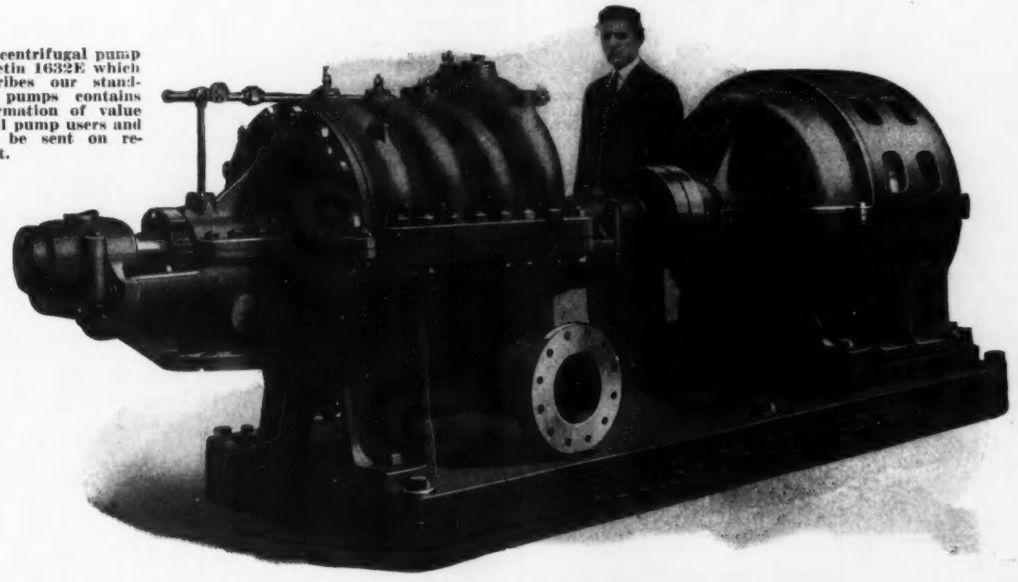

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